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ENGINEERING CONSTRUCTION WEEKLY

ENGINEERING NEWS-RECORD

FEBRUARY 16, 1939

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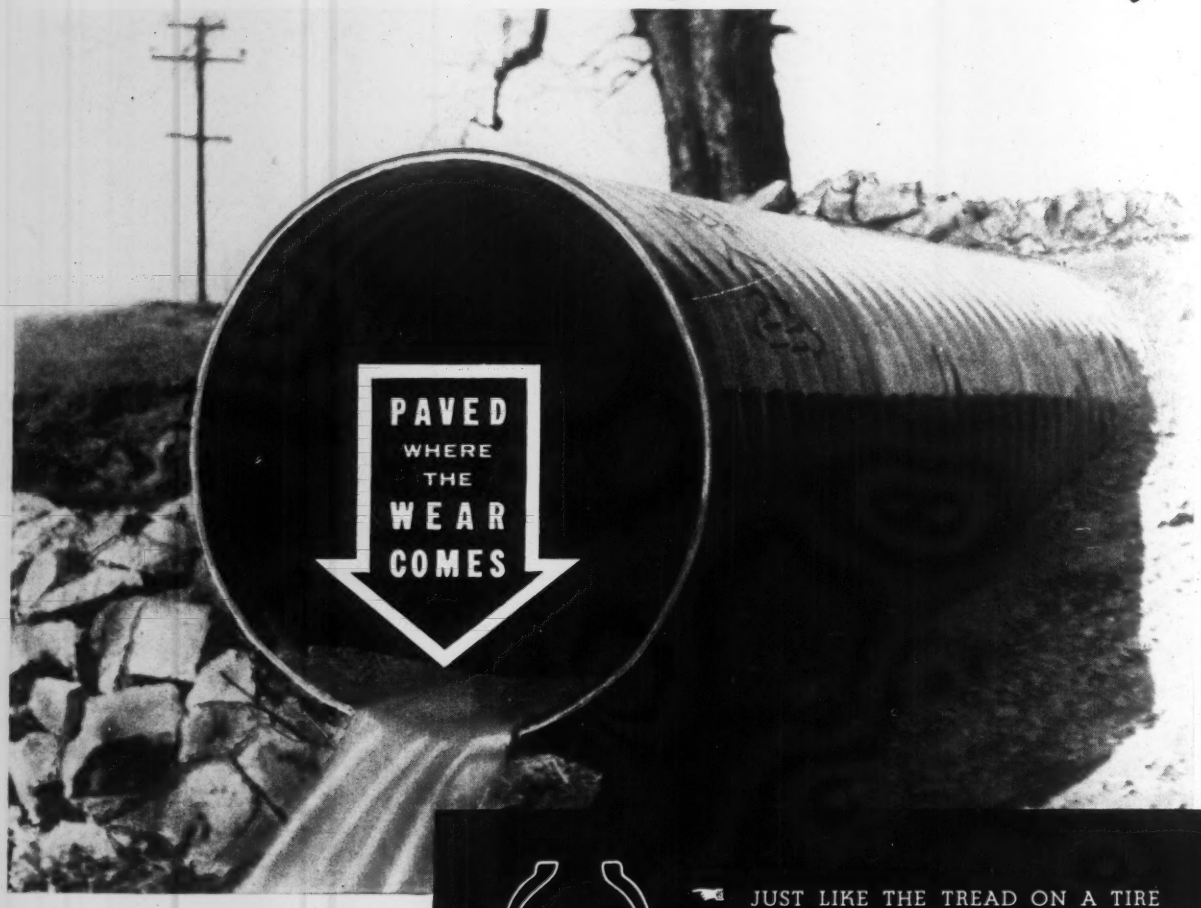
PAVING THE BOTTOM *Doubles its Life*



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THIS WEEK

● Preparations for the worst were made in planning the construction procedure for the south pier of the First Narrows Bridge at Vancouver. The caissons, although built for open sinking, were designed to be readily convertible for pneumatic use.

● Over half a million dollars is a lot of money to spend on a mile of road, but Baltimore is willing to foot the bill when it means a scenic parkway connecting two heretofore separated sections in the western part of the city.

● Add Pensacola Dam to your list of big dam jobs. It's just getting under way, and soon it will be as much a part of engineering construction news as Seminoe, Bartlett and Hiwassee. *News-Record's* first article on this Oklahoma power and flood control project appears in this issue.

THINGS TO COME

ENGINEERS AND CONTRACTORS will build better roads in 1939. Manufacturers are providing better materials and machines for building these roads. See the

HIGHWAY NUMBER, MARCH 2.

Features to be included are:

1. Individual statistics of highway mileages and expenditures in 1938 for 48 states.

2. The budgeted expenditures for highway improvement in 1939 reported for each state.

3. Controlling trends in state highway engineering.

4. Statistics of general construction for the eleven Rocky Mountain and Pacific Coast states.

5. Illustrations and descriptions of nearly 200 of the most modern construction machines and tools now available to engineers and contractors.

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THE WEEK'S EVENTS

Unified Works Program Proposed in Senate

Establishment of a Department of Public Works in the federal government is proposed in a bill introduced Feb. 9 by Sen. Byrnes. The new department would take over all activities of the Public Works Administration, the Works Progress Administration, the Civilian Conservation Corps and the National Youth Administration as well as the Bureau of Public Roads and the Public Buildings Branch of the Treasury.

The bill also establishes a formula for distribution of federal funds for works programs—one-half to be based on population, the other half on unemployment. States would be required to furnish at least one-third of the cost of projects.

Also included in the bill are a number of modifications of the present social security program.

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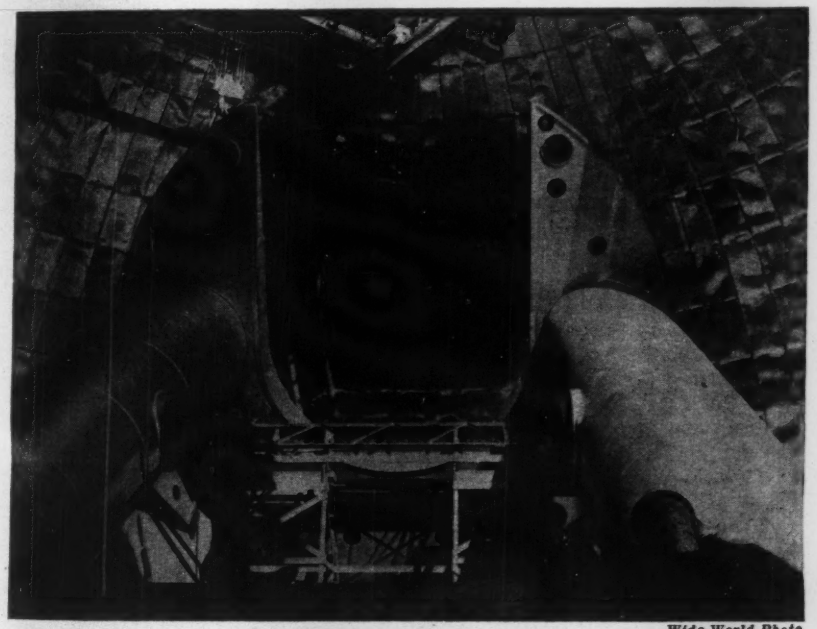
Senate Would Regulate State Drivers' Licenses

The Senate on Feb. 6 passed and sent to the House a bill prohibiting the operation of motor vehicles in interstate or foreign commerce by any

(Continued on page 38)



Wide World Photo

READY FOR THE MIRROR

SUPPORTING framework for the 200-in. reflector to be installed at the Mt. Palomar Observatory in California has been completed and now only awaits completion of the grinding of the 200-in. mirror, now in progress at California Institute of Technology.

The yoke section shown is equivalent to the standards of an engineer's transit except that it is supported at both ends, the horseshoe shaped member forming one rolling bearing, the other being out of sight in the immediate foreground. The axis of the yoke, midway between the two tubular members, is parallel to the axis of the earth. The telescope tube itself (actually an open framework) with the mirror at the bottom, will be pivoted about an axis running between the two openings visible above in the sides of the tubular members.

The man in the foreground gives an idea of the size of this big transit.

Ohio Road Body In Shake-up

New highway director halves number of resident engineer districts and cuts 1,600 off payroll

Since he came into office as director of highways under the new Republican administration last July 9, Robert S. Beightler has put the Ohio state highway department through a drastic reorganization. The changes have involved heavy reductions in personnel, consolidation of county highway districts to reduce the number of resident engineers, and inauguration of an economy policy in the purchasing division.

About 1,600 people have been cut off the highway department payroll. Most of these were provisional appointees, and many of them, it is stated, were hired a few weeks before the previous administration went out of office.

Previously, each of the 88 counties in the state had a resident highway

(Continued on page 41)

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Mile-Long Highway Tunnel Completed in Utah

The 7,000-ft. Bingham-Copperfield vehicle tunnel, built by the Utah Copper Co. for Salt Lake County, Utah, as a substitute for a road passing over an ore bed, was completed Feb. 5 at a cost of $1,400,000.

The old Bingham-Copperfield highway passed over ore-bearing lands owned by the copper company. Wishing to develop the ore fields by open cut mining, the company agreed to build the vehicle tunnel at its own expense and pay for the cost of maintaining it, in return for which the county abandoned the road. When mining is completed the company will build a new road.

The concrete lined tunnel is 12 ft. 4 in. wide and carries one lane of traffic and a sidewalk. One-way traffic, at six-minute intervals, is maintained in the tunnel, and travel is regulated by photo-electric cells.

Rate Base Change Urged on Court

Department of Justice asks U. S. Supreme Court to consider prudent investment as basis

A plea that the U.S. Supreme Court reconsider the traditional "fair value" basis for public utility rates which it enunciated in 1898 in the *Smyth* v. *Ames* decision was filed with the court last week by the Department of Justice in a friend-of-the-court brief. The fair-value rule, which directs that consideration be given to original cost, improvements, market value of securities, reproduction cost, and probable earnings under the proposed rate schedules, is attacked as being "unsound in principle", producing results that are "unreliable, arbitrary, and absurd". Under it the rate-making process is characterized as "costly, protracted and, in final result, unsound".

The brief was filed in the pending case of *Driscoll* v. *Edison Light & Power Co.* which challenges the Pennsylvania statute providing that, pending final disposition of a rate case, the state Public Utility Commission may prescribe temporary rates based upon a return of not less than 5 per cent upon the original cost, less depreciation, of the physical property. Under this law the Pennsylvania commission directed the Edison Light & Power Co. to institute temporary rates effecting a reduction in gross annual revenues of $435,000. Its order has been enjoined by a district court on the ground that the statute does not take into consideration the factors specified in *Smyth* v. *Ames* and is therefore unconstitutional.

The federal government, the brief makes clear, is concerned with the issues thus raised in two respects: First, a decision upholding the lower court would bar federal utilization of the temporary rate procedure, which has the advantage of permitting rate calculations to be checked by actual experience; second, the case offers an opportunity for a re-examination of the principles laid down in *Smyth* v. *Ames* which has, the brief argues, "proved unsound in principle and unworkable in practice". In its place the government suggests as a proper rate base the amount prudently invested in the property of the utility as applied to either temporary or final rate determinations.

The New York State Public Service Commission also filed a brief in the case, defending the principle of temporary rates. New York has a statute similar to the Pennsylvania law.

New York Planning Board Rezones East Side

The New York City Planning Commission has definitely recommended to the city Board of Estimate rezoning of the lower East Side area in Manhattan which it took under consideration a year ago (*ENR*, Mar. 3, 1938, p. 315). Under the proposed rezoning, about 42 per cent of the area would be zoned for residence use, 33 per cent for retail purposes, 15 per cent for business, and 10 per cent would be unrestricted. The area was formerly zoned almost entirely for business and unrestricted uses, although substantial residential developments have been made there.

The area involved extends south from 11th St. along the East River to James.

• • •

Gilbertsville Dam Dropped by House

Reviving an intra-Congressional controversy of last year, the House of Representatives on Feb. 8 dropped from the TVA appropriation provisions for continuing construction of the Gilbertsville Dam and for starting the Watts Bar Dam. By a vote of 159 to 122, the House reduced the TVA item in the independent offices appropriation bill from $39,000,000 to $21,797,000; also eliminated was an authorization to incur additional obligations amounting to $4,000,000.

Last year the House struck Gilbertsville out of the TVA appropriation, but, after the Senate restored the item, the House accepted a conference proposal that the appropriation for the dam be included.

Administration supporters expect the Senate to restore the appropriation to the original figure again this year and predict that the House will accept this action. They point out that the relatively small size of the vote gives an inaccurate idea of the support TVA will receive.

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Hours Law Exemption For Some Contractors

Highway contractors in Pennsylvania appear to be exempt from the 44-hour week provision of the federal wage and hour act in cases where permission to work a longer week has already been granted by the state highway department and approved by the U. S. Bureau of Public Roads, according to the new state secretary of highways, I. Lamont Hughes. With this exception, the secretary advises highway contractors to comply with the act.

"It appears to be difficult," wrote Hughes, "to obtain interpretations of the act . . . It seems that 44 hours in any week is the maximum for employment of any individual excepting administrative employees and, in the case of our contractors, those cases where the Bureau of Public Roads has already approved the working of longer hours on our contracts in specific instances.

"On projects where the regulations do not permit as much as 44 hours per week, these regulations are not waived or modified, except possibly by special authority . . . in accordance with present practice. In such cases, it appears that approval would not be given for more than 44 hours per week."

The secretary said, however, that in future the department would not approve a work week longer than that permitted by federal law.

• • •

Construction Work Racket Angers and Jails Doctor

Dr. Logan Clendening of Kansas City, a physician who conducts a newspaper health column, spent four hours in jail Feb. 10 as the result of his violent objection to the noise created by a compressed air machine and air drills being used on a WPA sewer project near his home.

The project has been under way since Oct. 1. Last week Clendening came out of his house and attacked the compressor with an ax, shouting meanwhile, "This damn rat-a-tat-tat, day after day, week after week, month after month, year after year, must stop. And I am going to stop it." Police then took Dr. Clendening to the station house, where he spent the next four hours in jail.

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Senate Would Regulate State Drivers' Licenses

(*Continued from page 37*)

person not possessing a state driver's license meeting certain minimum requirements. To receive federal recognition the state license must meet the following specifications: It must require the passing of an eyesight test, a driving test, and the ability to read and understand highway signs; it must be renewed at least once in every three years; it must carry a full and complete personal description of the holder; it must be issued only to a person 16 years of age or older.

If passed, the law will not become effective for four years to give an opportunity for revision of present state laws. Only 22 states now have licensing regulations meeting the proposed federal standards.

Condemnation Is Upheld For Jefferson Memorial

Right of the federal government to condemn land for construction of the Thomas Jefferson memorial at St. Louis was upheld by the U. S. Circuit Court of Appeals there in a decision handed down Jan. 28. Denying the claims of a property owner who brought suit to prevent condemnation of his land, the court said that although the Historic Sites Act, under which the Department of the Interior is carrying out the project, gives no explicit authorization to condemn land, a Congressional act of 1888 contains a general grant of power for any officer of the government to prosecute condemnation proceedings whenever he is authorized to acquire real estate.

The plaintiff also contended that construction of the memorial was not a public purpose and that, in any case, acquisition of his land was not necessary to carry out the project. On these points the court held that it was the function of Congress to determine what constituted a public purpose and that in the Historic Sites Act Congress had decided that construction of the memorial was for such a purpose. The Secretary of the Interior, moreover, had determined that the land in question was necessary to the project and, the court said, with certain exceptions not relevant in this case, such a decision of an administrative officer is not reviewable by the court.

• • •

Equipment Purchases Enjoined by Court

The Colorado Supreme Court has enjoined state highway engineer C. D. Vail from buying $258,000 worth of highway equipment in the open market without calling for competitive bids. A lower court decision (*ENR*, Dec. 22, 1938, p. 775) had previously held that Vail was entitled to make the purchases, even though state law requires that departmental purchases be made through the state purchasing agent. Before the injunction was issued, the highway department had received delivery on much of the equipment and warrants had been issued for payment of part of the total purchase price.

Rudy Arnold Photo

NEW YORK RUSHES CONSTRUCTION ON NEW AIR TERMINAL

ON APRIL 30, when the New York World's Fair opens, the city's new municipal airport at North Beach on Flushing Bay will also go into service. Four runways, from 3,600 to 6,000 ft. long, three 350x165-ft. landplane hangers, and the landplane administration building, shown in the above view, will be complete and ready for the transcontinental airlines. Three more landplane hangers (to the right, out of the picture) will be ready in Sept., and the seaplane facilities (to the left of the picture) soon thereafter. Mountains of ashes and refuse, excavated from Riker's Island in the background and trucked across the bridge, enlarged the site from 200 to 551 acres; some 80 per cent of the 14,000,000 cu. yd. required are already in place. Five hours from Chicago and twenty minutes from Times Square, this $30,000,000 air terminal is destined to be one of the world's finest and busiest.

President Urges Improved Planning

Commends National Resources Committee report stressing decentralization of planning

Enactment of legislation to continue planning work as a permanent activity of the federal government was advocated by President Roosevelt in letters made public Feb. 13 which he sent to Senator Byrnes and Representative Cochran with advance copies of the National Resources Committee's forthcoming progress report. Byrnes and Cochran are chairmen of the committees on government reorganization in the Senate and House, respectively.

"I am sending you the inclosed progress report of the National Resources Committee," the President wrote, "because it is more than the usual annual statement of a federal executive agency . . . It demonstrates the usefulness of the kind of planning service which, as I have recommended to the Congress, should be provided as a permanent establishment within the federal government.

"I hope that this report will be helpful to you and your colleagues . . . in the development and enactment of appropriate legislation to provide for continuation, correlation and decentralization of planning work."

Reviewing the experience of the National Resources Committee over the past five years, the report stresses that effective and accepted planning must come "from the bottom up" and must take into consideration the views of agencies in all levels of government.

"Plans based on facts and on research," says the report, "correlated plans and policies democratically developed and aimed to meet recognized needs, will find public acceptance and support. They will be better plans and more enduring policies than any schemes or projects forced on an unwilling minority by an authoritarian government."

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Civil Engineering Bureau For La. Conservation

A bureau of civil engineering has been created in the Louisiana Conservation Department. The bureau will be responsible for preparation of maps, establishment of boundary lines, filing of deeds and construction plans, and determination of original cost data, as well as the design and supervision of all the construction work of its department. Donald E. Fulehart is in charge of the new bureau.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

SENATOR BYRNES' BILL providing a permanent relief policy will be altered materially as it moves along its legislative course but it will probably pass the two houses of Congress. Another big battle with the President over the measure looms as a possibility. Congress has already decided that WPA is a failure. It may take an investigation to deal the agency its coup de grace but it is on the way out.

There will be a strengthening of Social Security. There will be an increase in direct relief. Work relief will become a part of the Public Works Administration even if the idea of a new department fails. The municipalities will be required to carry a greater part of the burden.

PRESIDENT ROOSEVELT signed Feb. 11 the joint resolution authorizing a $25,000 supplemental appropriation for the committee investigating the Tennessee Valley Authority. The committee is now working on its final report, which will not be completed for several weeks.

RE-STUDY of two reports on the proposed Florida Ship Canal to bring them up to date was asked of the departments of Commerce and the Interior in resolutions passed by the Senate Feb. 9. One of these reports concerned the effects of the Canal on ground water levels and supplies, while the other concerns possible commercial value.

FOUNDATION investigations at the site of the proposed tidal power development in Passamaquoddy Bay, Maine, were ordered by the Senate in a joint resolution passed Feb. 6. The resolution ordered the Secretary of War to complete surveys and borings and to report on the cost of building a small experimental plant at Passamaquoddy. The expenditures will be met from river and harbor appropriations.

DISAPPROVAL of immediate construction of a hydroelectric plant in the Cabinet Gorge in northern Idaho on the Clark Fork River has been announced by the Bureau of Reclamation. The bureau contends that a power development there would deprive Grand Coulee of a potential market for power and recommends that construction at Cabinet Gorge be deferred until Grand Coulee power has been absorbed.

PEDESTRIAN CONTROL regulations in a modified form have been adopted by the District of Columbia after several months of consideration. Several drastic proposals, including a rule against crossing any street except at a crosswalk, have been dropped; the regulations as promulgated require that pedestrians obey traffic signals and police officers at controlled intersections; use due caution when crossing streets elsewhere; and have the right of way over vehicles when using a crosswalk in obedience to a traffic signal.

PWA NOW HAS ON HAND 5,807 project applications which might be eligible for allotments if an additional appropriation were provided. Involving $994,700,000 in allotments, the projects have a total construction cost of $1,775,510,000.

THE SENATE Feb. 13 confirmed the nomination of Col. Roger G. Powell, Corps of Engineers, to be a member of the Mississippi River Commission.

• • •

New Waterworks Officials Are Nominated

J. Arthur Jensen, supervisor of the waterworks department of Minneapolis, has been nominated for the presidency of the American Water Works Association by the nominating committee. Unless another nomination is filed before March 1, Jensen will serve as president from the 1939 convention in June until the 1940 convention. Other officers nominated are Norman J. Howard, director of water filtration at Toronto, for vice-president, and William W. Brush, editor of *Water Works Engineering*, for treasurer.

At the annual meeting of the board of directors last month, the following were elected honorary members of the A.W.W.A.: Frank A. Barbour, Boston consulting engineer; Carleton E. Davis, manager, Philadelphia Suburban Water Co. at Bryn Mawr, Pa.; Charles G. Hyde, professor of sanitary engineering, University of California; Beckman C. Little, Rochester, N. Y.; and Harry E. Jordan, secretary of the A.W.W.A.

The Diven medal for 1939 will be awarded to Hal F. Smith of the department of water supply of Detroit and the John M. Goodell prize, established by *Engineering News-Record*, to David G. Thompson and Albert G. Fiedler for their paper on "Some Problems Relating to Legal Control of the Use of Groundwater" presented at the New Orleans convention last July.

The 1939 convention is to be held in Atlantic City, June 11-15, with headquarters at the Chelsea and the Ambassador hotels.

Detroit Incinerators Under Investigation

An investigation of Detroit's program of incineration of garbage and refuse has been ordered by the City Council, and a committee has been named to carry out the investigation.

The City Council's committee will investigate the planning and operation of the three incinerators which the city built as a PWA project at a cost of about $1,450,000. The incinerator project at its inception was approved by vote of the citizens in the belief that disposal by incineration would result in substantial economies. In January of last year the city's contract with the Detroit Reduction Co. was allowed to terminate in the expectation that the three incinerators would be completed. Only one of the incinerators was ready to begin operation at that time, however, and operation of this incinerator resulted in continual protests that it was creating a nuisance.

Last summer all the city's incinerators were shut down, and the city began burying its garbage as an economy move. A limited amount of incineration is now being done because the ground is frozen too hard for easy burying.

• • •

Illinois Sewage Operators To Receive Certificates

Certificates of qualification are to be issued to operators of sewage treatment plants by a committee of the Illinois Association of Sewage Plant Operators, the association has decided. The certificates will have no legal standing, but they will provide tangible proof of competence. They will be issued on request to sewage plant operators who meet the requirements.

Three classes of certificates are to be issued, with varying requirements for education, experience, and service rating. The service rating is based on knowledge of plant maintenance, operation control, the technique and interpretation of laboratory tests, on the ability to keep operation records and on professional activities.

The Class 1 certificate requires four years of college work in chemistry or engineering and six years' experience, of which four years are in responsible charge of operation. A service rating grade of 90 or more is required in each of the subdivisions. The Class 2 certificate requires four years of high school, three years experience, with one year in responsible charge, and a service rating of 60 or more. Grammar school graduates with a year's experience and a service rating grade of 30 may receive the Class 3 certificate.

Bay Bridge Officials Get New Jobs

C. H. Purcell and Charles E. Andrew, chief engineer and principal bridge engineer, respectively, of the San Francisco-Oakland Bay Bridge, have left the bridge project for new jobs on the West Coast. Purcell, who has also been California state highway engineer, has been selected by the supervisors of San Francisco as consulting traffic engineer for that city under a five year contract intended to protect him against change in the city administration. It is understood that the contract will involve resignation from his present state offices. His staff is expected to cost about $23,000 per year in addition to his annual salary of $20,000.

Charles E. Andrew's resignation, effective Mar. 1, permits him to accept a two-year contract with the State of Washington under which he will direct the design and construction of the Narrows Bridge at Tacoma and the Lake Washington Pontoon Bridge at Seattle. Andrew has worked in Washington before, having served for six years as state bridge engineer before he took a similar post with the California division of highways in 1927.

• • •

C. of C. Drafts Program For Construction

A program for stimulation of private construction based on the conclusions reached at the Construction Industry Conference sponsored by the Chamber of Commerce last October, has been drawn up and published by a special committee appointed at the time of the conference to study the results attained.

The committee strongly recommends cooperation of all elements in the industry in general programs to sell construction, such as the "More House for Your Money" campaign. The present sales advantage of reasonable construction costs is emphasized, and it is urged that profits from construction activities should be taken in the form of increased volume of sales and increased hours of work rather than higher prices and wages.

Long-range planning of public improvement programs by state, regional, and local planning boards is urged, and the committee recommends "serious consideration" of the rehabilitation of blighted urban areas by private housing corporations operating under some type of public utility franchise.

Tax revision to encourage long-term investments and construction are also advocated.

CHARLES E. ANDREW

Ohio Road Body In Shake-up

(Continued from page 37)

engineer, but by consolidating several counties into one district, the number of resident engineers has been reduced to less than half the former number. Four of the former resident engineers have been retained, and to date 27 new resident engineers have been appointed.

Nearly all the major positions in the highway department have been shifted. New appointments include: H. G. Sours as assistant director and chief engineer, succeeding Murray Anderson; Harry D. Metcalf, chief engineer of maintenance, succeeding X. G. Hassenplug; T. W. Kinnear, chief engineer of construction, succeeding Elmer Hilty; Glen R. Logue, chief engineer of location and design, succeeding Karl Ruthermund; Clyde Hadden, chief of the bureau of motor transport, succeeding F. E. Jolley. J. R. Burkey has been retained as chief engineer of bridges.

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Five Year Engineer Course Started at Rochester

To permit engineering students more time for the study of social sciences, literature, and similar subjects, the University of Rochester will initiate next fall an optional five-year course for engineering students. Including the same technical material as the four-year curriculum, the longer course offers the student ten elective subjects instead of the three provided by the existing arrangement. On completion of the five-year course, the student will receive both a bachelor of arts and a bachelor of science degree.

CIO Is Recognized On NYC Housing Job

FAECT recognized as bargaining agent for draftsmen on Metropolitan Life housing project

The Federation of Architects, Engineers, Chemists and Technicians, CIO affiliate, was recognized last week as collective bargaining agent for the architectural draftsmen employed on the $50,000,000 housing project which the Metropolitan Life Insurance Co. has under way in New York City. Chairman R. H. Shreve of Metropolitan Life's board of design, issued a memorandum covering specific conditions of employment pending the completion of negotiations for a definite contract which are now under way. Salary increases of about $5 per week have already been granted to the majority of the men.

Working conditions

Other results of the present negotiations contained in Shreve's memorandum provide for time and a half rates for all work over 40 hours per week and double time payment for Sundays and holidays. One day's vacation is provided for each month of employment, a week's advance notice of layoff, and observance of the principles of seniority consistent with architectural drafting room practice.

FAECT was recognized as bargaining agent after Prof. Talbot Hamlin of Columbia University certified late last month that the federation had been authorized by a majority of the employees to act in their behalf in dealing with the board of design. Hamlin had been chosen jointly by Shreve and the federation to verify the union's contention that it represented the majority.

A private project

The Metropolitan Life housing project is a private enterprise undertaken without government aid; it will accommodate 12,000 families. The project is being planned by the insurance company's staff in collaboration with the board of design.

In bargaining collectively with its architectural employees, Metropolitan Life follows procedure which has already been adopted on public housing projects in the New York area. Architectural draftsmen on the Queensbridge USHA project are covered by an FAECT contract with the employer architects, while draftsmen on the Red Hook project are represented by the International Federation of Technical Engineers, Architects and Draftsmen's Union, an AFL body.

Concrete Associations Meet in Chicago

Five associations in the concrete field hold simultaneous meetings at exposition

Speaking at a joint session of the five associations in the concrete industries field making up the Concrete Industries Exposition at Chicago last week, Frank T. Sheets, president of the Portland Cement Association, urged the members to "demand of yourself the highest standards of quality for your work and your products." Associations participating were the National Concrete Masonry Association, the American Concrete Contractors Association, the National Cinder Concrete Products Association, the Cast Stone Institute, and the Illinois Builders League. More than 50 manufacturers of concrete products, equipment and materials exhibited at a show held at the Sherman Hotel. Preliminary estimates put the amount of equipment sold at the show at more than $300,000.

That product manufacturers were endeavoring to better their products and improve their selling efforts was evident in many of the talks at individual meetings of the associations. B. F. Devine of the Chain Belt Co., chairman of the Mixer Manufacturers Bureau, pointed out refinements that have been made in equipment—largely directed toward greater control over material proportioning, greater portability, and improvement of mechanical details to decrease mixing expense and insure continuous functioning of all parts. A trend toward the use of vibrating equipment was apparent in all the equipment displayed.

Subjects of papers given before the associations included effective uses of forming and form accessories, placing concrete by the vacuum method, and the application of calcium chloride.

A cost analysis of concrete house construction made by R. E. Copeland of the development department of the Portland Cement Association, showed that reinforced concrete masonry work, including basement, concrete structural floors, and exterior walls and partitions, accounts for only 30 to 40 per cent of the total cost of the house. Exterior walls account for only about 10 per cent.

Harve E. Kilmer of the Iowa Crib & Silo Co. was elected president of the National Concrete Masonry Association; Carl Carlson, Minneapolis, was made president of the American Concrete Contractors Association; and Charles A. Petry, Champaign, was elected president of the Illinois Builders League.

Off-Center Center Line Brings Damage Suit

Damage suits totaling $65,000 have been brought against Kings County, Wash., on the ground that the off-center location of a yellow center stripe resulted in an accident causing the death of one man and serious injury of another.

The accident occurred on the Holman road, which had been widened in December and re-opened to traffic a few days before the accident. After the widening the yellow stripe which had previously marked the center of the highway was no longer in the center but to one side. The man who was killed is asserted to have been following the old yellow line when a car coming from the opposite direction crashed into his machine.

The county commission asserts that "The yellow stripe . . . was repaired as soon as it could be done. Rain fell every day for almost two weeks after the road was opened to traffic.

• • •

Cut in Lake Diversion May Create Nuisance

With the diversion of Lake Michigan water through the Chicago River reduced to 1,500 sec.-ft., pollution of the Illinois Waterway may be expected to create a public nuisance, the Sanitary District of Chicago states in its final report to the U. S. Supreme Court. Semi-annual reports have been made to the court ever since that body in 1930 ordered lake diversion gradually cut from 6,500 to 1,500 sec.-ft.

If the degree of treatment be considered as complete treatment for a certain percentage of the population, the present amount of sewage treatment will result in a dilution in the Illinois Waterway of only 0.37 sec.-ft. per 1,000 persons. Sewage works scheduled for completion in July will bring this figure to 0.78 sec.-ft., while completion of all work now planned will leave the dilution at 1.54 sec.-ft. per 1,000 persons. The district points out in its report that at least 5 to 6 sec.-ft. per 1,000 persons is required for adequate disposal of sewage by dilution.

• • •

Photogrammetrists Elect

Marshall S. Wright, photogrammetric adviser to the Agricultural Adjustment Administration, was elected president of the American Society of Photogrammetry at its annual meeting in Washington. He succeeds Virgil Kaufman in this position. First and second vice-presidents elected are Leon T. Eliel, vice-president of Fairchild Aerial Surveys of Los Angeles, and John A. Whittle, member of the contact sales division of Eastman Kodak Co., Rochester, N. Y. The committee on aerial camera specifications submitted its tentative specifications (*ENR*, Sept. 15, 1938, p. 316) to the board of direction, and action will probably be taken on them soon.

WHERE THE WORK STOPPED

CHANNEL WORK on the Los Angeles River by the U. S. Engineers got as far downstream as this point, just above the Gayton Ave. Bridge, in 1938. No further work will be done until after the winter rains.

The Southern Pacific R. R. yard (at the right in the view above, which is taken looking upstream) as well as a number of the houses in the left foreground, were damaged in the March, 1938 flood. The channel protection work already done is believed to provide sufficient protection for the winter.

Damages Held Due On Floodway Land

The United States must pay damages to land owners in the Eudora floodway to compensate them for the increased probability that their lands may be flooded, the Circuit Court of Appeals at St. Louis held Feb. 8, reversing a lower court decision. Fuse-plug levees protecting the floodway are so designed that they will go out before the main Mississippi River levees are overtopped, thus relieving the pressure on the main levees.

The case was a test suit filed in 1934 by Mrs. J. C. Stonenbarger, who contended that her 48 acres of land in the floodway had been reduced in value from $5,000 to $1,000 because of the increased danger of floods. Other suits for damages totaling about $50,000,000 are now pending, awaiting the outcome of the test suit, and the total amount involved may reach $135,000,000.

The government will ask for a rehearing of the case, the U. S. district attorney at Little Rock has announced, and if the rehearing is denied, the case will be appealed to the Supreme Court.

CONTRACTS AND CAPITAL

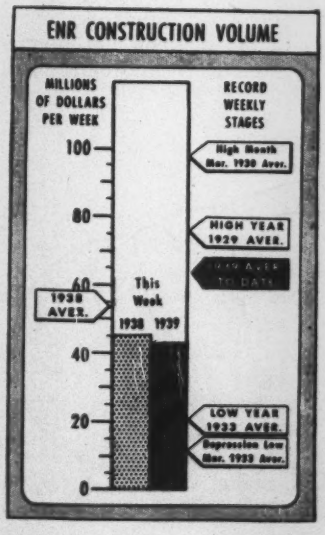
ENGINEERING construction awards for the short week (due to the Lincoln's Birthday holiday) total $42,410,000, a 6 per cent decrease from the volume in the corresponding 1938 week. Construction awards for the year to date, $454,673,000, are 30 per cent higher, however, than the $360,826,000 reported for the initial 7-week period last year.

Public construction for the week is 21 per cent above the week last year due largely to the increase in earthwork and drainage volume. Private awards are 36 per cent below a year ago.

The earthwork and drainage volume is the highest for the year to date. The $6,000,000 Santee-Cooper site-clearing project in South Carolina is responsible. In addition to earthwork and drainage, bridges, waterworks, and unclassified construction are higher than in the 1938 week, and waterworks, commercial building and large-scale housing, and public building are above last week.

New capital for construction purposes for the current week totals $10,587,000, and is made up of $9,495,000 in state and municipal bonds, and $1,092,000 in corporate security issues. This week's volume is 49 per cent below the total for the 1938 week.

New construction financing for the year to date, $135,055,000, is 8 per cent above the $126,389,000 reported for the corresponding weeks last year.



CONTRACTS

(Thousands of dollars)

	Week Ending Feb. 17 1938	Feb. 9 1939	Feb. 16 1939
Federal	$2,073	$2,209	$5,635
State & Municipal	21,851	28,179	23,205
Total public	$23,924	$30,388	$28,840
Total private	21,077	11,146	13,570
TOTALS	$45,001	$41,534	$42,210
Cumulative 1939 (7 weeks)			$454,673
1938 (7 weeks)			$360,826

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1938 7 Wk.	1939 7 Wk.
NON-FEDERAL	$126,389	$135,055
Corporate securities	61,230	19,737
State & Mun. bonds	61,909	99,687
R.E.A. loans	.....	15,631
R.F.C. loans	2,109	.....
PWA allotments	1,141	.....
FEDERAL	.....	.....
TOTAL CAPITAL	$126,389	$135,055

FHA MORTGAGES

	Week Ending Feb. 12 1938	Feb. 4 1939	Feb. 11 1939
Selected for appraisal	$8,787	$19,784	$21,168*
Cumulative 1939 (6 weeks)			$109,103*
1938 (7 weeks)			$50,668

* Subject to revision.

ENR INDEX NUMBERS

Index	Base		1913	1926
Construction Cost		Feb.	234.31	112.63
Building Cost		Feb.	196.23	106.08
Volume		Jan.	287	126

OBITUARY

NOAH CUMMINGS, recently appointed director of the bureau of bridges of the public works department of New York City, died suddenly in Mount Vernon, N. Y., on Feb. 13. Cummings was 65 years old and had been in engineering work for New York City since 1894 continuously except for army service during the Spanish-American war. His principal work was in the former bridge department and the department of plant and structures. He was appointed to his new position with the bureau of bridges Jan. 1.

DAVID YOUNG, retired civil engineer of Towaco, N. J., died in St. Petersburg, Fla., Feb. 6 at the age of 89. Young retired from active practice in 1908, having served as vice-president of the North Jersey Traction Co. and as consulting engineer for Brown Bros., investment bankers.

JOSEPH H. LANDRY, district engineer since 1937 at Montreal for the Canadian department of public works, died there Feb. 2 at the age of 50. Landry joined the public works department in 1913 after his graduation from Laval University.

FRANK W. LAWLOR, 83, superintendent since 1903 of the Citizens Water Co. of Burlington, Iowa, died there recently.

JOSEPH N. GREGORY, 88, Buffalo civil engineer, died in Buffalo Feb. 2. Gregory was chief engineer of the International Railway Co. from 1895 to 1915 and on numerous occasions served the city of Buffalo as a consultant.

OSCAR J. HANSON, Seattle civil engineer employed by the Boeing Airplane Co., died in Seattle Jan. 28 at the age of 49.

EDWARD F. CONDON, secretary of the Boston Transit Commission and associated with the commission since 1896, died in the city of Boston, Jan. 21 at the age of 63.

FRED L. BIECHELE, executive director of the Ohio unemployment compensation commission, died in Columbus, Jan. 21, at the age of 45. From 1935 to 1937 Biechele was chief of the maintenance division in the Ohio state highway department, and earlier he had been district engineer at New Philadelphia. Biechele was at one time city engineer of Canton and earlier served for ten years in the office of the county surveyor in Stark County.

(Further news on page 83)

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Reduction of Plans

Sir: The article by E. L. Sanders, photostat operator with the state highway department of Colorado, entitled "Reduction of Engineering Plans Cuts Operating Costs" (*ENR* Dec. 29, 1938) was very interesting. About a year ago this district started experiments to find a practical, as well as an economical method of reducing plans. The method finally decided upon is virtually the same as the method used by the Colorado highway department with a few exceptions. Instead of using the photostat process, we use a photographic film with a thin paper base of the type commonly used by the newspapers for line photography. The result is that the fine lines stand out much clearer because of the deeper opaque background of the photographic film. An engraver's camera is used in making the reduced photographic reproduction and it is possible to make approximately 70 photographs per hour. The cost of 12 x 18-in. film is 11c. each.

One more feature has been added to the process of which Mr. Sanders writes. A Van Dyke print is made from the photographic negative and this black lined Van Dyke becomes the negative from which our blue print and black and white prints are made. The Van Dyke negative is printed in the 24 x 36-in. size and contains four of the 12 x 18-in. reduced negatives. It is therefore possible for the operator to produce four times as much work as can be printed when using standard size drawings for printing.

There are several advantages in using the Van Dyke reproduction instead of the photostat or photographic negative. First, it is possible to fade out and make changes, or show additional data on the Van Dyke negatives. This would be difficult to do on the opaque or photographic negative. Second, the opaque negative prints very slowly and, by using the black line Van Dyke, negative printing can be speeded up to the extent that we can realize a saving of 75 per cent in printing time over that required to make prints from the photographic negatives. During the last ten months of 1938, our blue print room produced 135,000 reduced prints, in addition to other routine printing which consumed about 30 per cent of the actual time worked by the crew. This work was accomplished with one vertical type printing machine and auxiliary facilities.

GEORGE E. JOHNSON
Chief Engineer and General Manager
The Central Nebraska Public Power and Irrigation District
Hastings, Neb., Jan. 9, 1939

Arbiter or Advocate?

Sir: Permit me to add a word to the current discussion in your columns regarding "the engineer, arbiter or advocate?" I maintain that:

1. The engineer is logically the interpreter of his own plans and specifications, and in the best position to say what he intended them to mean and what is required for satisfactory execution of the work.

2. The engineer is, by many court decisions, in a disinterested and impartial position as between owner and contractor, although paid by the owner. The logic of this is not evident until you consider the fact that if paid ostensibly on a joint basis by owner and contractor, the contractor would add this item to his bid and the owner would thus pay in the end.

3. Development work is seldom satisfactorily performed except when there is no relation between owner, engineer and contractor, and when the engineer is under firm contract not subject to cancellation at the whim of either party, and thus in a position to act impartially.

4. The owner's interests are best served by an engineer who has the courage to act impartially and fairly even under pressure from either party to do otherwise. The bids received by an owner are influenced considerably by the reputation of his engineer for fair and impartial decisions.

It is most astounding to read a recent comment from an engineer advocating that an engineer should not be impartial but should represent his employer's interest. The engineering profession would certainly be stooping to a very low level if this opinion were general.

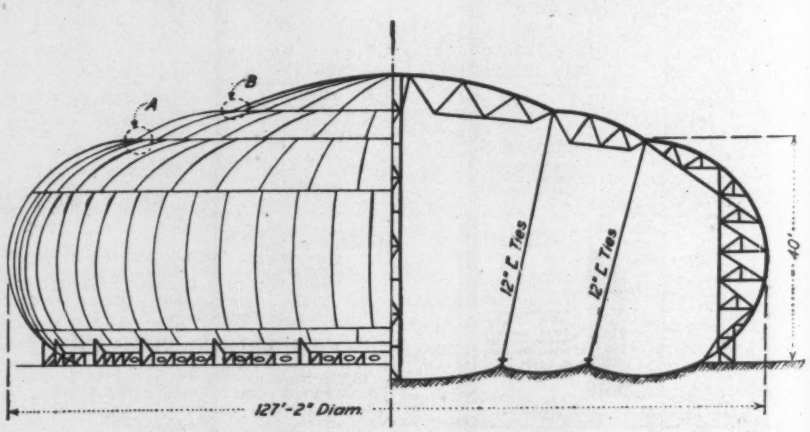
L. F. HARZA
Consulting Engineer
Charleston, S. C. Dec. 20, 1938

Sarnia Tank Explosion

Sir: In connection with the photograph, in your issue of Nov. 10, of the spheroid tank which exploded at Sarnia, Ont., Sept. 21, the following facts may be of interest.

The tank, an 80,000-barrel spheroid intended for pressure storage of gasoline, was of welded construction throughout, joints calculated in accordance with the A.P.I.-A.S.M.E. code requirements with 0.1 in. corrosion allowance. All welding work was inspected, and plug samples were taken from many of the seams. Some of the welding was condemned on visual inspection and the seams chipped out and rewelded.

In the test compressed air at a pressure of 15 lb. per sq.in. was introduced and the tank was allowed to stand for a period of 38 hr. Water was then admitted slowly to the tank, excess air being expelled through safety valves set at 15 lb. per sq.in. During this process pin-hole leaks were found at points on opposite sides of the tank on the circumferential seam above the outer circular



girder marked *A* on the attached sketch. Air pressure was removed and these seams were chipped out and rewelded. Pressure was restored and then released again to repair a leak discovered 7 ft. above the bottom of the tank, after which air pressure was again restored.

On Sept. 21 the entire upper portion of the spheroid shell ruptured. Water was being admitted at the time of the rupture, and just before the break there was 14 ft. 7 in. of water in the tank, equivalent to 30,500 bbl.; air pressure had just reached 15 lb., as indicated by the hissing of the safety valve.

The upper portion of the tank plating was torn and folded in all directions. Four tears extended down through the side plating nearly to ground level, the deepest ending about a foot above grade, while four irregularly shaped pieces of tank plating were torn loose from the structure.

It is believed that the failure was caused by faulty welding at the junction of the shell plating, the roof plating, and the outer circular girder at the seam designated *A* on the sketch. There is no known relationship between the point of initial failure and the leak described earlier, except that they were in the same circumferential joint.

The detail section in the upper half of the sketch shows the construction at the point of failure. The outer circular girder terminated at the top in a 2x1½-in. rectangular bar on which the shell plating and the roof plating terminated. They were joined to the bar by a single butt weld for which the bar itself acted as a backing up strip. Examination of the wreckage showed that at many points along this girder bar poor fusion of the weld into the bar or no fusion at all had been secured, the total length of these poorly welded sections amounting to 5 to 10 per cent of the circumference of the girder. Much of the poor welding was concentrated at one section of the bar, and it is believed that failure started at this point. Evidently, after the failure the welded joints tore free from the girder bar progressively in both directions, allowing the plate to spring upward, and placing a strain for which the tank was not designed upon the joint at the inner circular girder. Seam *B* is identical with *A*, and evidently failed throughout the entire circumference in a manner similar to *A*. Since the stresses on the roof plating were by this time of far greater magnitude than the original design allowed for, the plating proceeded to tear in all directions.

A good weld was somewhat more difficult to make at joint *A* than at a normal butt welded seam, and, moreover, these seams could not be adequately inspected either visually or by removing test plugs.

A contributing factor to the magnitude of the failure was that the structure was tested with air before it was tested with water. This caused a large volume of air to be stored in the tank and greatly increased the potential energy of the explosion. Had the structure been filled or nearly filled with water before applying the test pressure, the extent of failure would have been very much less.

There is no indication of any defect in the original design. Other structures of identical design but with considerably higher unit stresses and no corrosion allowance have been satisfactorily tested under all conditions of liquid and gas loading and in addition have had a test pressure of 22½ lb. per sq.in. applied with the tank filled with water.

General Engineering Department
Standard Oil Development Co., New York
Nov. 9, 1938.

Designing Circular Tanks

Sir: In "Standards of Design for Concrete", published by the Bureau of Yards and Docks, The U.S. Navy Department, a method is given for designing circular tanks.

What perplexes me very much is that under certain ratios of height of walls to the product of length of radius and wall thickness, and under an assumption of rigid connection between walls and base, the base moment will reverse—that is to say, that instead of causing tensile vertical stresses on the inside of wall, the vertical stresses will now become tensile on the outside and compressive on the inside, while the ring stresses for a certain height of wall will become compressive instead of tensile; this, of course, under an unchanged condition of loading, namely horizontal pressures from within, *i.e.* a more or less filled tank.

As I, and probably others also, would feel very doubtful about using this method, which seems to give so illogical results, until assured by the author or the publishers that these results are correct, I ask you kindly to publish this in the proper column of your valuable magazine in the hope that enlightenment may come.

I. S. RASMUSSEN
Hillsdale, N. J., Jan. 24, 1939

Williamsburg Floor Slabs

Sir: In the Brief News notes (*ENR* Dec. 22, 1938, Adv. page 16), the item referring to the construction of Williamsburg Houses, New York City, is erroneous in vital particulars. These structures were designed as rigid reinforced concrete frames by the writer using a uniform slab depth of 6 in. supported on reinforced rectangular concrete columns with a prefabricated structural steel head of my own design entirely contained in the slab thickness. A similar design had been employed in several buildings prior to its application in the 1,500,000 sq. ft. of this government housing project. Its most recent application is in the 100,000 sq. ft. of the Museum of Modern Art now being completed at 19 W. 53rd St., New York. In that structure, the slabs are 9, 10 and 11 in. thick on 24-ft. spans for superimposed loads of 100, 150 and 200 lb. per sq. ft. respectively.

The infringement suit brought against the U. S. Government in the Court of Claims by Walter H. Wheeler of Minneapolis for damage claims amounting to $72,000 did not reach adjudication but was voluntarily dismissed at Mr. Wheeler's initiative upon payment of a nominal settlement of $5,000 by the general contractors, Starrett Brothers & Eken, Inc., New York City, to secure release and final payment from the government on its contract. The system of construction used in the Williamsburg Houses is not an infringement of Mr. Wheeler's smooth-ceiling method of flat slab erection nor of any patent rights owned by him. The U. S. Government did not pay any royalties for its use nor has it contracted to do so in the future. Mr. Wheeler's action resulted in a withdrawal of the suit against the government.

GEO. E. STREHAN
Consulting Engineer
New York, N. Y., Jan. 7, 1939

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Editorial Offices at 330 West 42nd Street, New York

FEBRUARY 16, 1939

BONUS PAYMENT for increased efficiency in certain concreting operations at Grand Coulee Dam is unusual enough in construction today to have rated general mention in the news of the last few weeks. To an older generation the announcement will recall a period thirty years ago when bonus and piece-work wage plans occupied much time in discussions of contracting practice. No wage rating method ever devised has offered more incentive to the individual workman and more promise of profit to construction management. Taylor, Gantt, Emerson, Halsey, Gillette and other engineers were building up massive records of evidence to support this conclusion, and the Associated General Contractors published a comprehensive report on ways and means of applying bonus wage methods. Now a single example is news; actual practice is almost unknown. Why this lack of interest in a management plan that held so much promise and which thirty years ago was believed to be based on sound principles?

A Debt to the Past

LARGE engineering projects have on occasions paid the debt that they owe to the past by furnishing money to finance some needed research. The authorities in charge of the San Francisco-Oakland Bay Bridge are the latest to embrace this happy practice, and the tests of large riveted joints, reported on another page of this issue, together with fatigue test results reported last year, represent their contribution to the knowledge of the future. Engineers in charge of large projects, be they bridges, tunnels, buildings, waterworks or sewage plants, should make this practice a commonplace. It is not enough to budget funds for research necessary to the project in hand. Some should be put aside for studies vital to the advancement of engineering knowledge in fields where more knowledge is needed. Every great engineering project is compounded not alone of materials and labor but of accumulated knowledge as well. In payment for the use of this knowledge, funds from the project should make the accumulation of more knowledge possible.

Rivet Design Practice

IN ONE SENSE it is inconceivable that great structures like the Philadelphia-Camden, the George Washington, the Golden Gate and the San Francisco-Oakland bridges could be built according to specifications that are based on tests of small riveted joints made thirty or more years ago and with steels that were unknown when the tests were made. In another sense it is typical of the way advance has often been made, moving from one project to another on the strength of repeated experience and success. Limits and applicability of the old specifications thus gradually are broadened. And when doubts of the assumptions become too great, new tests are made. In the case of the large riveted joint tests financed by funds from the San Francisco-Oakland Bay Bridge and reported at the recent meeting of the Am. Soc. C. E., past practice, so far as safety is concerned, is shown to be satisfactory. Efficiency in the use of metal and designers' time, however, apparently can be improved. The tests indicate that no advantage is gained by using complicated rivet patterns in an attempt to secure a maximum net section; full row riveting, in fact, gives superior results. Effect of rivet pitch on joint strength is small compared with transverse spacing, which appears to have an optimum value of about 4 diameters. It is proper to assume equal distribution of load among rivets regardless of size of joints. These conclusions would seem to give designers a chance to simplify their practices in the interest of greater efficiency in both design and fabrication.

Combination Waste Disposal

SEWAGE AND REFUSE DISPOSAL are two of the necessary but expensive services for which municipalities must provide. Operating costs are particularly high in small communities if separate disposal plants are maintained and properly supervised. Decided reduction in costs is possible, however, by combining sewage treatment and refuse incineration facilities in a single waste disposal plant. Experience at Herkimer, N. Y., described on page 71, clearly points to the practicability of such an installation. Principal advantages of the scheme are the opportunities for mutual assistance between the two processes, centralization of similar activities at one site, and the economy of having

only one operating staff. Small communities desirous of providing efficient sanitation service at lowest cost will find much of merit in combination waste disposal.

Pay for Engineers

TENTATIVE standard classifications with corresponding rates of compensation for three grades of engineers were made public by the board of direction of the American Society of Civil Engineers following its January meeting in order to obtain the widest possible discussion before the board gives its final approval. Summaries of the classifications were given in ENR Jan. 26, p. 6; they are set forth in full detail in the February number of *Civil Engineering*. Briefly, the classifications cover the three lower grades of assistant engineer, positions calling for engineering school graduates (or men with equivalent technical training) and for practical experience ranging from none for the lower grade to four years as minimum for the highest grade. Salary schedules range from $2,040 to $3,840.

No general rates of compensation for work which can only be defined in broad terms can be laid down which will be found to be applicable under all conditions. This fact needs to be recognized in any discussion of the subject as well as in the actual application of the rates. Arbitrary fixing of rates of compensation is not sought; rather, the objective is to provide a measure by which to judge the reasonableness and fairness of compensation. Ultimately, regional factors should be determined which can be applied to the basic rates. Then it will be possible to say with authority that the rates paid men for a particular class of work or job are below or above a fair and equitable rate for that class of work under the living conditions of a particular region. This should be helpful in checking the exploitation of engineers.

What has been done in publishing these classifications and rates is but the first stage of a long operation. Other classifications with corresponding rates, especially those for subprofessional work, must follow, and all must be broken down again into regional rates. The American Society of Civil Engineers alone cannot be expected to handle the infinite details involved; this is work in which the state societies and associations of professional engineers should carry the greater part of the burden. Only with their support and cooperation can this useful undertaking be made fully effective.

Earthquake Knowledge

NOT SINCE 1923, when Tokyo and Yokohama were nearly destroyed, has an earthquake exacted such a toll of life and property as did the one which rocked south central Chile on January 24. Reports that 15,000 persons were killed and a half-dozen towns and two small cities destroyed indicate that it was one of the major earthquake disasters of modern times. Furthermore, if the epicenter, as reported, was between Chillan and Concepcion, the two largest towns involved, the destructive force of the quake must have been as great as any on record.

Yet despite these ideal conditions for study of a major earthquake, there is grave question whether knowledge of earth action will be greatly enhanced. It is feared that the Salto Observatory at Santiago and other nearby seismic study stations obtained no useful recordings, due to damage to their instruments. Also, from the few news pictures of wreckage that have come out of Chile, it is apparent that the general type of building used was particularly vulnerable to earthquakes. This, of course, gives the quake a high intensity rating on the Rossi-Forel scale, but it provides structural engineers with no information on the period of the motion, its maximum amplitude or its acceleration. These, as usually, must be deduced from uncertain data.

In the United States, thanks to the U. S. Coast and Geodetic Survey, there are now numerous installations of strong-motion accelerometers and of displacement meters, which can operate in close proximity to major earth shocks. The first recordings from the accelerometers, and indeed the first actual recordings of a destructive shock anywhere, were made at Long Beach, Cal., in 1933. Here, high accelerations from 0.3 to 1.0 g, accompanied by a vibration period of 0.1 sec. occurred for a few seconds at the beginning of the quake, followed by movements of 1- to 2-sec. periods with accelerations of 0.04 g. Significantly, most of the damage occurred after the high accelerations had passed.

The conclusion that was drawn from the Long Beach records, namely that structural damage is more apt to be caused by resonance between the earthquake period and the natural period of vibration of the structure than by high acceleration is still the best guide that structural engineers have. Studies of the Chilean earthquake will be useful but, if unaided by actual instrument readings, they can hardly advance earthquake knowledge to any great degree.

FIG. 1. TRACK IN THE SOLEDAD CANYON WAS RAISED AND REALIGNED TO ELIMINATE RIVER CROSSINGS.

Southern Pacific Relocates Canyon Line

Contents in Brief—Following serious washouts during the floods of last March the Southern Pacific Co. relocated ten miles of its line through Soledad Canyon to raise the grade, eliminate river crossings and improve alignment. Much of the work was done by raising and shifting the existing line under traffic, using both man and machine for the shifting work.

TEN MILES of the Southern Pacific Company's line through Soledad Canyon of the Santa Clara River, about 50 mi. north of Los Angeles, was relocated last summer following serious washouts in the floods of March. The change eliminated ten river crossings in 2 mi., raised the track above high-water level and greatly improved the alignment. The original line was located in 1876. It crossed and recrossed the winding river to obtain an easily graded line. The rebuilt line has been straightened and new channels have been cut for the river to keep it on one side of the railroad as much as possible. In some places the grade has been raised as much as 17 ft.; changes of as much as 9 ft. in elevation and horizontal shifts of 65 ft. were made without taking the line out of service more than three hours. The total cost including bank protection, culverts and channel work was $650,000.

When preparing for raising the grade on the sections of the line that were kept in service during the change, the filling material was dumped by trucks on 10-cu.yd. carryalls at convenient points close to the track from which point bulldozers were used to distribute it into windrows along and under the ends of the ties as the track was lifted. The lifting was done with track-shifting machines with power jacks. Lifts were limited to 14 in. to avoid kinking the rail. While the track was held up, men with shovels worked the fill material under the ties until the space was filled. These lifts usually affected the track to a slight extent for about two rail lengths.

After each lift and the subsequent filling in by hand, the machine was moved ahead half a rail length and the operation was repeated. Working along the track in this way, using a crew of about 40 men, it was possible to complete one 14-in. lift (net raise about 1 ft.) in the 3-hr. period on a 650-ft. length of track. Successive lifts were made until the track was up to the new grade requirement.

For throwing the line sidewise a lift was first made to free the ties from ballast, using the jacks on the throwing machine, and then tractors

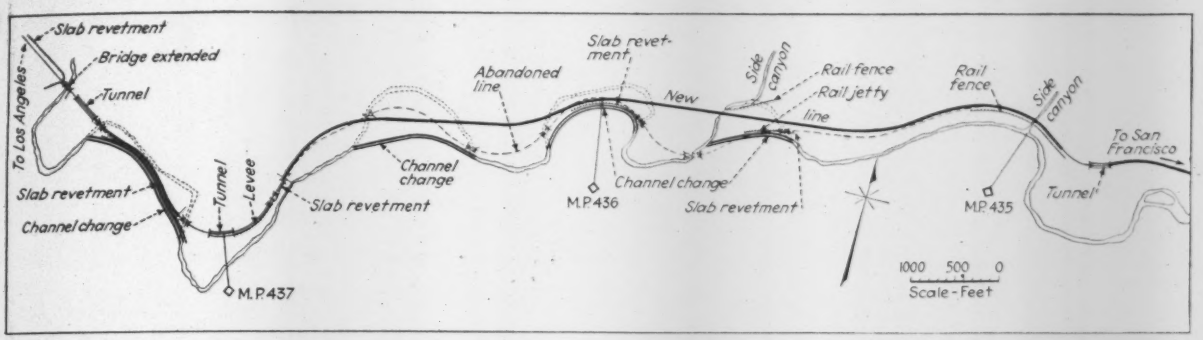

Fig. 2. Ten river crossings were eliminated in the relocation of the canyon line and the track was protected against floods.

were used to pull the track. Usually three tractors were used as a matter of time economy. On each pull the track could be moved sidewise as much as 3 to 10 ft., depending upon conditions. Then each tractor would move along the track one rail length and another pull would be made.

In lateral movement of the track care had to be taken not to kink the rails. Danger of kinks, as in the lifting, was the limiting factor in the permissible throw at each pull. Risk of kinking was lessened materially by use of a tie laid behind the rail at the point where the cable was attached.

Ballast was salvaged on much of this work and the cost of ballasting in the new location was reduced by using bulldozers for gathering up ballast along roadbed from which track had been lifted and for distributing it in windrows along the ends of the ties in the new location. In some cases carryalls were used to transport the ballast. Where the lateral shift was not far, the bulldozers shoved the ballast from old to new locations.

Grading on the Santa Clara Canyon relocation was done by contract, of which there were several. All handling of track and ballast was done by company forces under the general direction of W. H. Kirkbride, chief engineer, Southern Pacific Co.

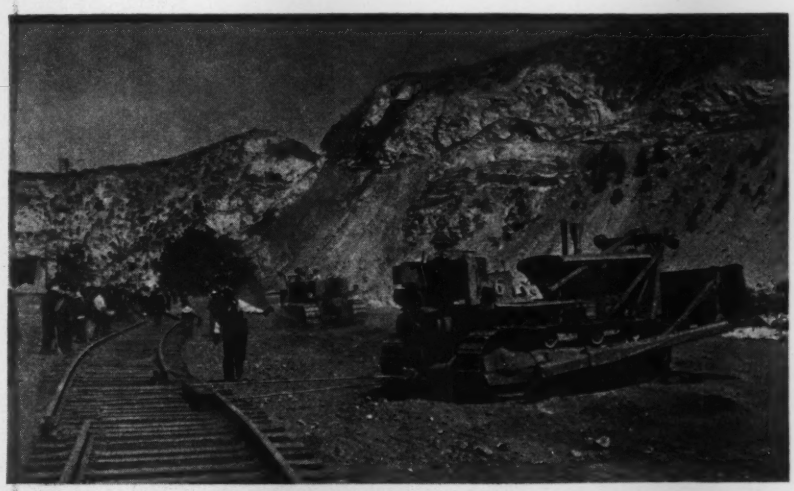

Fig. 3. Tractors were used to do much of the track shifting, but the final work of getting the track to its new line was done by the old "Yo Heave" method.

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Industrial Report Ready on Eleven Western States

A comprehensive survey of industrial resources in the eleven western states, which has been in progress for many months by a technical staff under the direction of George W. Malone, former state engineer of Nevada, has been completed and is now in the hands of the printer. Presenting an exhaustive compilation of data on water resources, industrial fuels, power, mineral resources, agriculture, transportation and numerous other topics, the report will comprise two volumes of 700 to 800 pages each, including maps, charts, graphs and statistical tables. The compilation of the data has been financed by The Industrial West, Inc., 111 Sutter St., San Francisco, a non-profit organization which will supply copies of the report at a price to cover only printing and distribution costs. However, the number of extra copies to be printed will be based on the number of requests received before it goes to press.

Low-Cost Plant-Mixed Retread

LEONARD H. M. WHITNEY
County Engineer, Montgomery County, Fonda, N. Y.

UNUSUALLY INTERESTING COSTS of traveling-plant-mixed bituminous road surfacing were obtained during the past season (1938) in Montgomery County, New York. While broken down in far more detail in the county records, the cost items included in the accompanying summaries furnish about every detail that is commonly wanted by the road engineer. Briefly, traveling-plant-mixed surfacing on 30 mi. of road cost $2.30 a ton and using the traveling plant for mixing material for patching reduced the cost per ton in place to $2.34 below the average costs of 1937.

Montgomery County has a considerable mileage of gravel and old macadam roads that should be given a new bituminous top course. For several years the county had been building retread surfaces by the mixed-in-place method and fairly good results were being achieved but as engineer I felt that the results could be improved, oil saved and a denser road secured by using a plant mix. But it was financially out of the question to use M.M.Type 3 or 5 mixes from commercial plants; the material would cost $4.75 a ton at the plant which, with the haul and work of laying, would bring the cost in place to about $7 a ton.

As the result of careful study into traveling plant operation in 1937, decision was made to purchase a heavy duty machine of the Barber-Greene type. In 1938 this machine built 30.01 mi. of roads of varying width from 12 to 18 ft. and was used later for mixing cold patch material for all macadam roads in the county. Experiments were made with four grades of asphalt cutback, and the coarse aggregate used was in most cases a good-grade limestone, a mixture of No. 1, 2 and 3 stone. On one road, a screened crushed gravel of No. 1 and 2 grades was used and 30 per cent clear sand added to the mix with RC-3 asphalt cutback. This road was finished with a finishing machine, and a very smooth surface resulted.

On another road, the mixer was located at a county quarry where it was possible to windrow the aggregate in a 1,500-ft. arc and the traveling plant loaded and mixed the stone directly from the windrow and loaded it on trucks and the finisher spread the mixed aggregate.

COST OF TRAVELING MIXING PLANT RETREAD IN MONTGOMERY COUNTY, NEW YORK

No. of road	Length miles	Running time hrs.-min.		Stone cost per ton at mixer	Ave. haul miles	Total stone used tons	Cost per ton mile	Bituminous material kind	Cost per gal. mixer	Percent of mix	Gallons per sq. yd.
1	6.50	62	44.8	$1.169	5.25	7107.27	$.0807	RC-3-4	$.0712	.0469	1.309
2	1.20	10	6.4	1.155	3.10	1124.05	.1303	RC-4	.0712	.0485	1.192
3	2.38	23	53.9	1.541	18.70	177.85	.0424	RC-4	.0712	.....	.....
				1.455	11.20	2790.85	.0406	64-R	.0772	.0430	1.305
4	0.19	2	9.9	1.744	16.00	299.35	.0465	69-M	.0772	.0382	1.366
5	1.50	8	35.1	1.109	2.75	1189.25	.1414	64-R	.0772	.0452	1.270
								69-M			
								RC-4	.0712	.0452	1.270
6	2.26	19	5.7	1.277	4.70	2138.56	.1291	RC-3-4	.0712	.0492	1.640
7	3.95	35	30.9	1.530	4.30	4168.27	.1239	RC-3	.0712	.0420	1.289
8	0.342	2	20.5	1.785	6.00	296.30	.1308	RC-3	.0712	.0424	1.188
9	1.98	17	17.9	1.602	8.00	1859.25	.0753	RC-3	.0712	.0487	1.376
10	0.082	..	48.5	1.590	15.00	94.40	.0393	RC-3	.0712	.0457	1.583
11	6.44	58	20.7	1.511	14.50	2875.20	.0352				
				1.199	9.70	2463.00	.0409	RC-4	.0772		
				2.060	19.70	1824.95	.0680	RC-3	.0712	.0423	1.359
12	0.19	1	27.4	1.523	12.00	165.00	.0436	RC-3	.0712	.0484	1.205
13	2.17	19	5.2	1.277	3.00	2154.56	.0923	RC-4	.0712	.0473	1.334
14	0.56	4	25.2	1.659	3.00	498.42	.2198	RC-4	.0712	.0473	1.256
15	0.27	2	26.5	1.191	3.00	275.52	.0635	RC-4	.0712	.0473	1.224

COST OF TRAVELING PLANT RETREAD — (Continued)

No. of road	Gal. per ton mixing	Mixing cost	Total tons mixed	Cost per sq. yd. mixing	Cost per ton mixing	Finishing cost per ton	Finishing cost per sq. yd.	Total cost per ton	Total cost per sq. yd.	Total cost per ton finished
1	11.73	$912.24	7457.24	$.0136	$.122	$.180	$.020	$2.11	$.2685	$2.41
2	12.12	159.33	1181.31	.0133	.135	.177	.017	2.12	.2293	2.33
3	10.74	271.65	3102.03	.0145	.120	.157	.019	2.33	.3021	2.49
4	9.53	60.70	311.23	.0279	.195	.470	.054	2.70	.4645	3.24
5	10.28	161.24	1245.59	.0145	.129	.165	.019	2.24	.2706	2.41
6	12.29	263.08	2249.16	.0156	.117	.233	.031	2.73	.3858	2.89
7	10.51	628.23	4351.10	.0177	.144	.200	.025	2.39	.3499	2.85
8	10.60	50.73	309.42	.0184	.164	.586	.065	2.62	.3770	3.36
9	12.18	340.42	1954.51	.0197	.174	.296	.033	2.61	.3596	3.18
10	11.42	13.97	98.92	.0196	.141	.858	.119	2.61	.4813	3.47
11	10.58	968.87	7479.57	.0166	.130	.228	.029	2.42	.3667	2.85
12	11.91	352.08	2261.51	.0176	.156	.341	.038	2.34	.3257	2.89
13	12.11	29.04	173.40	.0166	.167	1.225	.122	2.40	.4228	4.25
14	11.83	67.46	523.19	.0137	.129	.518	.055	2.61	.3547	3.34
15	11.83	40.43	289.20	.0144	.140	.967	.100	2.17	.3688	3.56

(8) Streets — town of Florida.
(10) WPA job,— town of Glen.

Convertible Caissons for Bridge Piers

Contents in Brief—Two types of caisson were used for the main piers of the Lions' Gate Bridge at Vancouver, each designed to meet peculiar local conditions. Open circular caissons were used for the south pier which was in swift water. They were designed for conversion into pneumatic caissons should conditions require. The north pier caisson was designed for open dredging. Dynamite was used to get final settlement.

THE SUSPENSION BRIDGE recently completed across the First Narrows of Burrard Inlet at Vancouver, B. C., known as the Lions' Gate bridge, provides a new and greatly shortened route from the westerly end of the city to residential areas across the inlet to the North and West. Construction on this toll bridge was started early in 1937 and it was put into service in November, 1938.

The main span of 1,550 ft. has a 614-ft. side span at either end. The roadway is 29 ft. 4 in. wide with two 4-ft. sidewalks. Minimum clearance under the birdge is 200 ft.; height of the main towers is 360 ft. 6 in. from piers to base of saddle and the deck is suspended from two pairs of 13 in. cables 3,396 ft. long.

Length of the main span was originally set at 1,500 ft. as a minimum, which was selected, in large measure, because of locations thought best for piers and anchorages. The Dominion Government required changes that increased the span to 1,550 ft.

The two main piers were constructed by entirely different methods because conditions differ widely on opposite sides of the channel. On the south shore the foundation is in rock at a depth less by 35 ft. than was required for the north pier. Swift currents around the south pier, however, made it by far the more difficult and its construction program was worked out in such a way that the open caissons could have been readily converted to pneumatic methods had that become necessary.

South pier caissons

The south pier was built in two separate parts each constructed within its own circular caisson surmounted by a cofferdam. Above water level, the two shafts are cruciform in plan. This pier is about 130 ft. off-shore from the high tide mark; the foundation is sandstone; high water depth is about 40 ft., and tide velocities range up to 7 knots.

The first drilling and blasting of the foundation, carried on from floating equipment, went down to about El. 60 (high water El. 97.77); loosened material was removed by a dipper dredge. Two benches, one for the cutting edge of each caisson, were then leveled by divers. While this excavation was going on, the caissons were being constructed on shore nearby. Details of the caissons and method of seating them are given in Fig. 2.

The cutting edges of the caissons,

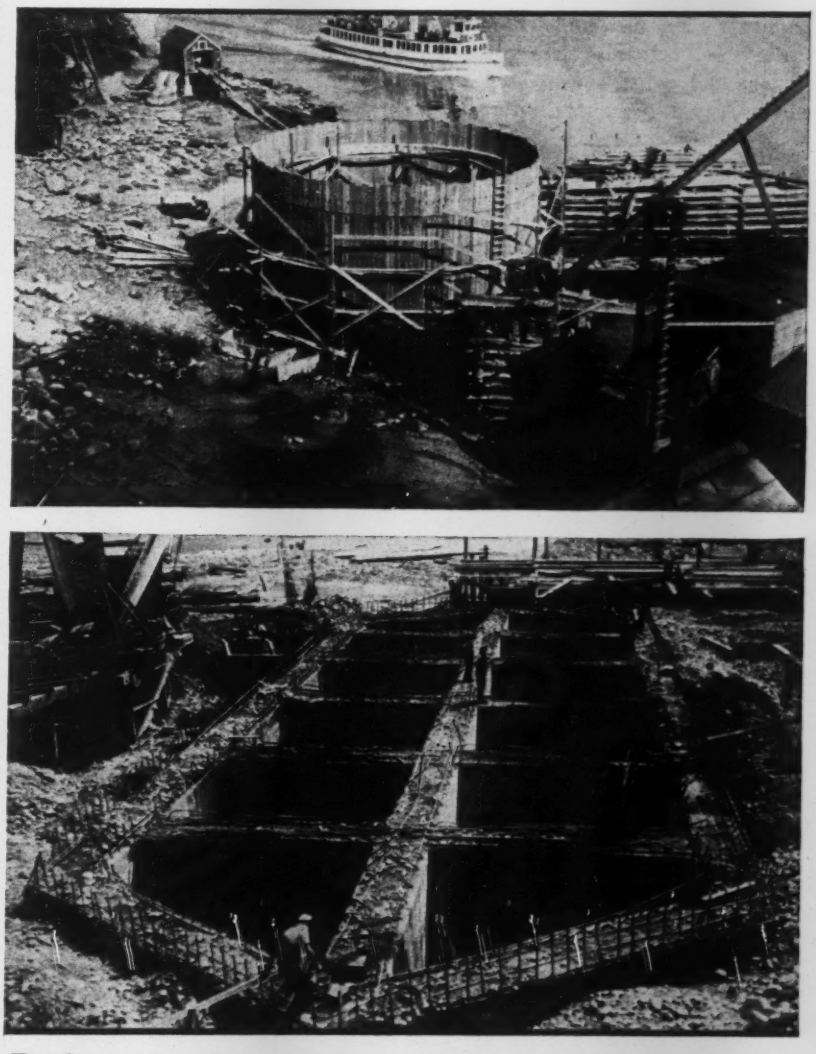


Fig. 1. One of the south main pier caissons in process of being built up on shore (top), and the north pier caisson after it had been sunk to place.

48 ft. in diameter and 6½ ft. high, were structural steel. On this assembly were carried two pair of steel trusses, one pair set normal to the other, straddling a 10-ft. steel shaft. Into the bottom chords of the trusses was framed a grid of I-beams, which, when concreted in, would form the roof of the pneumatic caisson if the conversion were necessary. The steel shaft, extending above water level, could be fitted with an airlock.

While the caissons were still on shore some concrete was placed in the roof and cutting edge, and a shell of 4-in. planking 24 ft. high was built above the steelwork, stiffened near the top by a laminated timber ring. They were then floated to position, more concrete added to the roof and edge, and a 12-in. concrete wall poured inside the plank shell. A laminated timber cofferdam, sheeted on the outside, was then built above the concrete wall and two valves installed to flood the cofferdam to hold the caisson in position after landing.

Compressed air not required

From the outset the plan had been to seal the caisson to the rock with tremie concrete placed around the outside, thus obviating the need for compressed air unless the rock was found to contain water-bearing seams. This sealing had to be done in a water depth of about 40 ft. The method used was to first build a retaining wall along the seaward side of the caisson to hold the tremie concrete in place. This wall was made with 6x3x3-ft. concrete blocks supplemented by boxes of gravel and sacks of sand. When this was ready, tremie concrete was deposited to a depth of about 5 ft. and 2-in. grout pipes were put down in it at about 4-ft. centers. Sacks of sand and concrete placed by divers inside the caisson prevented the concrete from flowing in.

When the concrete had set, grout pipes were drilled out, the drill was extended downward into the rock and the holes were grouted. The caisson then was pumped out and excavation was begun within the protected area.

The east caisson was first to be seated and unwatered. Before excavation started a leak developed under the edge, quickly enlarged and flooded the chamber. This was found to be caused by a layer of sand between solid rock and the tremie seal which had not been properly cleaned off before placement of the concrete. Instead of resorting at once to pneumatic measures, another effort was made to put tremie concrete around the leaking sector, this time taking care to clean the bottom thoroughly before pouring the seal. The second attempt was successful and the leakage thereafter was only a small flow.

In each caisson paving breakers were used to excavate a trench for circular cut-off wall just inside the perimeter of the cutting edge. In this trench a ring of concrete 2 ft. thick was poured extending above the bottom of the cutting edge and thus giving an additional seal should there be any softening or spalling of the rock. The remainder of the rock to be excavated then was taken out, carrying the bottom down to El. 55.3 in the east caisson and 55.9 in the west caisson. To establish the elevation at which it was safe to stop the excavation, drill holes were sunk to about El. 41 at each pier site, and a small test pit was sunk to El. 49 at the east pier site. Information from these holes indicated that nothing would be gained by further excavation. The concreting was then carried up to El. 83.25 and final grouting of the working chamber was done.

North pier caisson

The north pier was at a location above water level at low tide and it was decided to build it by the open dredging process. The first step in construction was to level off the site and place upon it a timber mat on which to erect the cutting edge and the first section of the single caisson that served for both shafts of the pier. Cross-wall cutting edges were 2 ft. higher than the outer wall edge and hence were put on higher blocking.

The entire blocking system was laid out to give uniform support to the structure during erection and yet to be readily removable when sinking operations began. These requirements were met by using wedges and key timbers. During high tides the blocking was held down temporarily with steel rails. Details of the caisson are shown in Fig. 4.

A feature of the design of the cutting edge was maintaining of steel area at intersections so that there would be no reduction in steel in the cutting edge for carrying tension. At the intersection of cross-walls this was accomplished by welding a plate under the edge in one direction and two angles on the inside of the edge in the other direction. Where cross-walls joined the outer wall, two angles were welded to the inside of the cross-wall edge and were carried

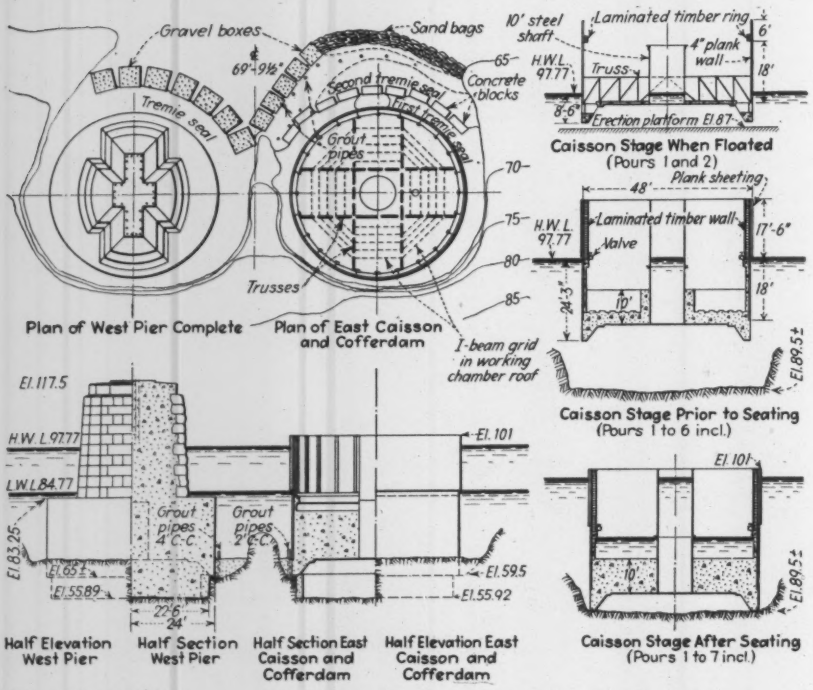


Fig. 2. Construction sequence on the south pier caissons and cofferdams.

through the outer wall to join a vertical angle in the plane of the outer surface. All corners and joints were reinforced with cover plates extending a foot higher than the cutting-edge plate. All steel work of the cutting edge was welded, including field connections, except for the riveted horizontal ties in the angle frames.

With the structural steel welded in place, forms were built around the cutting edge to a height of 7½ ft., reinforcing was placed and the forms were filled with concrete in a continuous pour. Reinforcing was designed with the assumption that the cutting edge always would be kept in tension during sinking. On this assumption it would be safe to use less steel in the upper portion of the first pour.

The design assumption of low tension at the top of the caisson was not fulfilled as the gravel under the east end was soft and the caisson listed in that direction, opening up a number of cracks in the top. However, after excavating by hand at low tide around the inside edge, the caisson leveled off again putting the cutting edge in tension. No further trouble was encountered during sinking.

Excavation was done with orange peel buckets operated by two derricks which were carried on piles driven before the caisson was assembled. At the start there was some question as to whether derricks on these piles could be kept up to grade. The piles could be driven down only to El. 80 and they were within the zone of moving ground caused by sloughing under the cutting edge. However, a crew kept constantly on watch at each pile cluster was able to keep the derricks to required grade by a nominal amount of jacking and blocking up.

Anchor bolts for the pier cofferdam were placed in the top caisson pour and when the last pour was in, the cofferdam was erected to a level above high water and sinking of the caisson was continued.

Dynamite aids sinking

The last downward movement of the caisson (some 44 in.) before starting the cofferdam, was obtained by exploding two 1¼-in. sticks of 60 per cent dynamite at the bottom of each pocket. Explosives were used two or three times a day for the remainder of the sinking.

The caisson was stopped when the cutting edge reached El. 20.32. After backfilling had been carried to El. 26 eight sticks of dynamite were shot on the bottom and additional settlement of 0.04 ft. was noted. Four months later, after completion of the pier, a further settlement of 0.233 ft. had taken place which brought the cutting edge (average of four corners of caisson) to El. 20.047. The cutting edge was put down 72 ft. in a period of three months working the crews three shifts per day.

The eight end pockets were backfilled with sand and gravel to El. 37, and the four center pockets to El. 69.25. The end pockets were then filled with tremie concrete to El. 51.5, making a 14½-ft. seal, while the center pockets were filled to 74.25, making a 5-ft. seal.

When these seals had set and the caisson was unwatered, it was found that the upper 6 ft. of the circumferential wall, which had been reduced in thickness to provide a shelf for seating a top slab, had cracked in a number of places, presumably by stresses developed during sinking. This upper 6-ft. rim, besides being thinner than the main wall below, had no lateral support, as all the crosswalls were stopped at El. 74.25 underneath the 6-ft. slab which was to be poured in a continuous mat like a huge lid to the caisson. None of these cracks extended downward into the main wall, and were consequently easily accessible for sealing from the inside, which was done with quick-setting cement.

After unwatering, the eight end pockets were filled with concrete poured in the dry to El. 74.25, and the 6-ft. covering slab was then added, bringing the whole surface to its final elevation of 80.25.

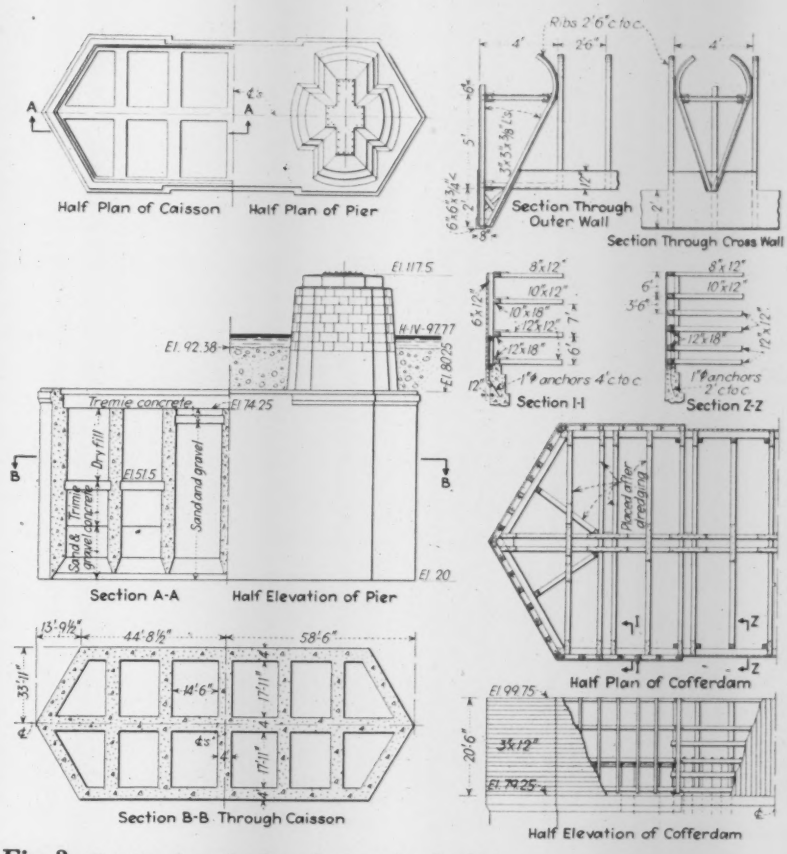


Fig. 3. Details of north pier caisson and cofferdam.

Personnel

The bridge is owned by the First Narrows Bridge Co., Vancouver, B. C.; it was designed and built under the supervision of Monsarrat & Pratley, consulting engineers, Montreal, Quebec. W. G. Swan, Vancouver, was associate engineer; J. W. Roland was resident engineer for Monsarrat & Pratley. The substructure was constructed by Stuart Cameron & Co., Ltd.; W. F. Way, superintendent.

Thin Concrete Shell Roof For Ice Skating Arena

ANTON TEDESKO
Engineer of Structural Design, Roberts & Schaefer Co., Chicago

Barrel-shaped roof is supported on 116-ft.-span two-hinged concrete arches

BASED ON requirements of a column-free floor, a light but nonglaring interior, insulation from the warmth of the sun's rays and economical construction, an efficient skating arena has been built in Ardmore, Pa., by the Philadelphia Skating Club & Humane Society. Materials used are concrete and glass. The arched roof is of thin concrete shell type, and it covers a plan area of 105 × 235 ft. within which an 85 × 185-ft. ice arena is accommodated.

Arches and shell monolithic

As shown in the accompanying illustration the structure of the building consists of a number of units each made up of two arches on 29-ft. centers and the concrete shell roof. Arches and shell are monolithic, the shell connecting the two arches and cantilevering 9 ft. beyond each.

A gap is left in the roof shell between adjacent units and thus a natural skylight area is formed where—from the construction standpoint and from the standpoint of expansion—the skylights logically belong. The skylights, of corrugated wire glass, extend above the curved crown of the roof, providing sufficient pitch to avoid dripping due to condensation. Glass blocks are used in the sidewalls.

The arches of 116-ft. theoretical span, which support and stiffen the curved roof shell, are built as two-hinged, with a 34-ft. rise above the ice level. On the exterior of the hall, the intersection of the arches and side-walls is emphasized by concrete pilasters, connected to pile-supported footings with semi-hinges. Tension members, 14 × 14 in. in section, consisting of concrete-incased bars, tie the bottom of the arch pilasters across the hall below the ice surface.

Skating hall in Ardmore, Pa. housed under a concrete arch and shell roof. Skylights are in expansion joint locations

The cross-sectional curve of the shell is multicircular, the radius at the crown being 80 ft. and at the spring line 45 ft. Near the crown, where the shell, stiffened by its continuous curvature can carry loads in all directions, the thickness of 2⅝ in. is governed by buckling strength. Near the springing line, however, the thickness is increased to 4½ in. to resist the stresses developed in holding the edge of the curved shell in proper balance.

Construction procedure

Wood falsework and forms were provided for one unit of the roof, which was poured in a continuous operation. High early-strength cement was used and the concrete vibrated as placed. Cork ceiling slabs, 1 in. thick, for acoustical and insulation purposes, were laid on the forms and the concrete was poured on top of them without the use of mechanical anchorage. Because the concrete used was of rather stiff consistency, no top forms were required for pouring the roof shell.

Decentering was accomplished by the gradual lowering of screw jacks which put them under stress at the same time as arch thrust developed during decentering operations. When the forms had been lowered clear of the roof, the falsework was moved into position under the next unit and the construction sequence repeated.

A club room, office, locker rooms, etc., for 650 people are located adjacent to the front wall of the building on the first floor and on a balcony floor. Facilities are provided to seat 1,500 people around the ice surface of the arena. A small basement at the south end contains the boiler room and freezing equipment.

Costs

The cost of the structure including foundations was $3 per sq.ft. of plan area or 10c. per cu.ft. of building. Fully equipped, but without refrigeration, the cost was $4.40 per sq.ft. or 15½c. per cu.ft., while the refrigeration plant added $1.10 per sq. ft. and 3½c. per cu.ft. to the cost.

E. Nelson Edwards of Philadelphia was the architect; Roberts & Schaefer Co. of Chicago were the designing and supervising engineers; and Sauter & Schwertner of Philadelphia, the general contractors.

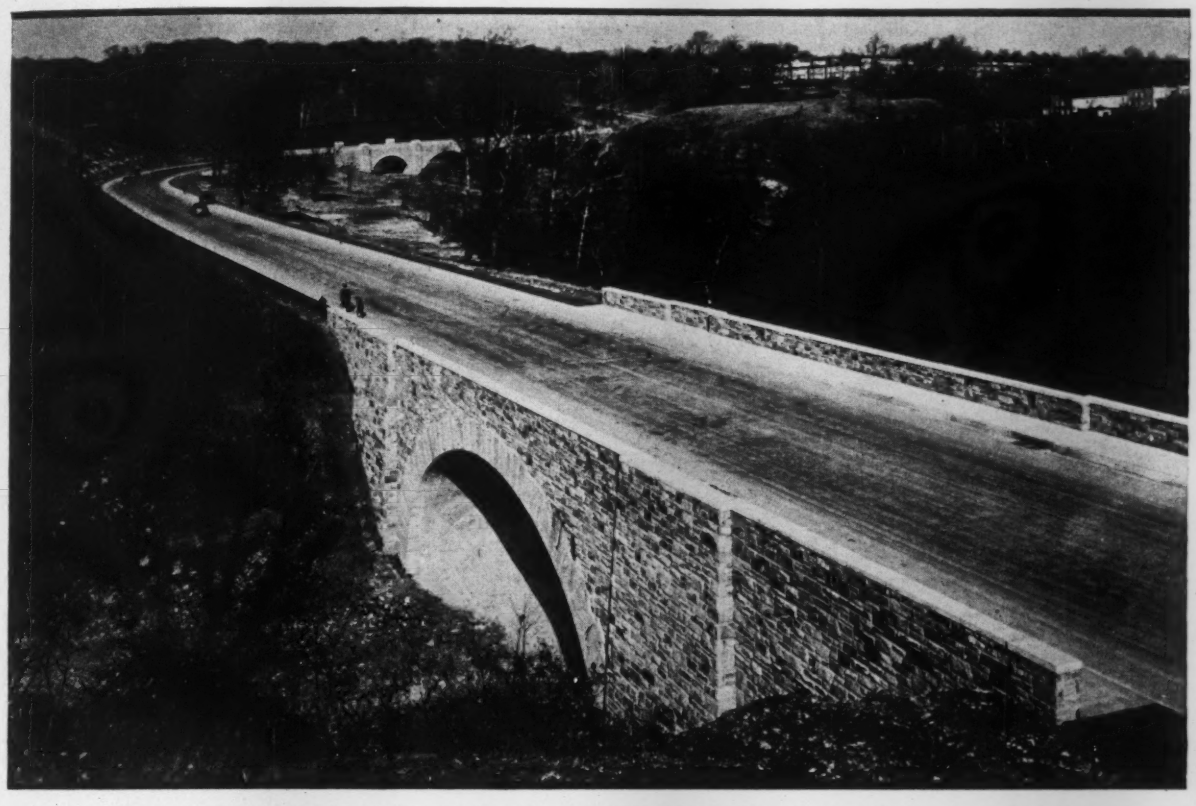


FIG. I. HILTON PARKWAY SPANS THE TRAFFIC BARRIER OF GWYNNS FALLS VALLEY IN BALTIMORE.

New Parkway Aids Baltimore Traffic

GEORGE COBB

Highways Engineer, Department of Public Works, Baltimore, Md.

Contents in Brief—Lacking arterial street service north and south in west Baltimore, the city has opened a wide parkway over the long-time barrier of Gwynns Falls valley. Paving and bridge work are described.

UNTIL LAST FALL the valley of Gwynns Falls, a small stream entering Patapsco River from the northwest, has barred north and south arterial traffic in west Baltimore. In November (1938) one of the finest city parkways built in recent years was opened to break the barrier. Only about a mile long, this parkway has cost $561,000 and, as the illustrations show, is an exceptionally handsome development.

The accompanying sketch map shows the spot location of the new road. It fills the gap made by Gwynns Falls valley in Hilton St. between North Ave. and Edmondson Ave. At this location a part of the valley is occupied by a city park (Gwynns Falls Park) which greatly simplified right-of-way difficulties common in arterial street improvement. The city park commissioners granted a 40-ft. strip across park land for the new road. Being on the line of Hilton St. the new parkway has been given the same name. In the length of a little over a mile there are 75,000 cu.yd. of grading and two bridges.

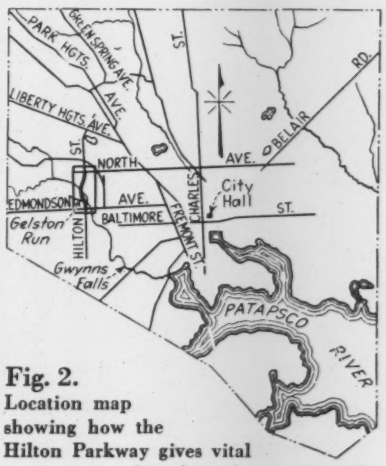


Fig. 2. Location map showing how the Hilton Parkway gives vital service to north and south arterial traffic.

A sturdy pavement

The parkway is paved 40 ft. wide between curbs, with 3 in. of sheet asphalt on an 8-in. base of 1:5½ concrete. To stabilize the foundation and to prevent free groundwater from seeping under the paving and softening the subgrade, perforated corrugated metal pipes were installed

in gravel-filled trenches to discharge into the storm sewer system. During the fine grading, the subgrade was further stabilized with limestone crusher screenings.

The base itself was constructed in lanes, across the longitudinal construction joints of which ⅝-in. steel dowel bars were imbedded on 4-ft. centers. The coarse and fine aggregates for the concrete base were batched to the site where cement was added in a portable paver. The batch formula was predicated on the absolute volumes of the several ingredients in the finished mixture. The mixing time per batch of concrete was 90 sec.; the concrete was machine finished, in the sheet asphalt paving, 65-penetration asphalt cement was used in both binder and surface mixtures. The batch formula for the binder was set for 5 per cent of bitumen with 25 per cent of 10-mesh material; the surface mixture carried minimums of 10.5 per cent and 12 per cent of bitumen and filler, respectively. Special concrete curbing was provided, the upper edge of the face being rounded to a radius of 4 in.

Handsome bridgework

As previously stated, the work included two bridges, one over Gwynns Falls valley of five spans of earth-filled, skewed masonry arches, and the other over Gelston Run, a tributary of Gwynns Falls, a single-span earth-filled masonry arch.

The three central spans of the larger bridge are 90 ft. each, segmental in shape, and the two end spans are 60 ft. each, elliptical in shape. The span of the smaller bridge is 65 ft. Both bridges are constructed throughout of reinforced concrete, all of which, with the exception of the arch soffits, is faced with stone. The spandrel walls are of the counterfort type, and the approach retaining walls of the cantilever type. All pier, abutment and wall foundations were carried down to solid rock.

The arch voussoirs, which are a random combination of Dunn Mountain and Caroline Pink granite cut in random widths and lengths, were set before placing the arch concrete and securely anchored to it. The soffits of the voussoirs have a bush-hammered finish and the outside surface is cut with a rock face and pitched edges. Pier nosings, band courses, parapet coping and other trim were entirely of Carolina Pink granite with bush-hammered exposed faces. The spandrel walls, retaining walls and parapets, are faced with gneiss granite obtained from a quarry close to the site of the work. This stone was laid as coursed rubble, with specified size limitations but, unlike the arch voussoirs, was laid after the structural concrete work was completed. Generally, the face of the stonework is 18 in. from the face of the concrete, the space between being backfilled with concrete and all well anchored together.

The overall width of the bridges is 55 ft., which provides a roadway 40 ft. wide between curbs and two footways each 6 ft. wide. The overall length from end to end of approach walls of the larger bridge is 673 ft. and of the smaller bridge 170 ft.

The lighting of the bridge roadway is somewhat unique and worthy of mention. It is accomplished by reflected light from luminaires placed in the stone parapets on each side. The optical system consists, essentially, of a prismatic spread-light door lens, plus an internal aluminum parabolic reflector. In addition, a series of horizontal louvres, attached to the bracket supporting the reflector, definitely eliminate objectionable glare above the horizontal through the lamp filament, the general effect being to distribute the light accurately and uniformly over the roadway surface. The luminaires are spaced 60 ft. apart. This lighting arrangement is believed to be the first of its kind to be installed on a bridge in this part of the country. It offers quite a distinction from the usual practice of installing elaborate standards, but the essential purpose of providing a lighted roadway is better accomplished.

Directing officials

Work on the Hilton Parkway was started under the direction of the late chief engineer, Bernard L. Crozier. It was carried to completion by the present chief engineer, Frank K. Duncan, with the assistance of the author as highways engineer, Herman F. Lucke, bridge engineer, and O. H. Schroedl, designing engineer of bridges, all of the Department of Public Works, Baltimore, Md. Henry S. Shyrock was project engineer, and A. M. Taylor, resident engineer-inspector for the PWA. Lucius R. White was consulting architect in connection with the bridge designs. The bridge contractor was Frank Angelozzi & Sons and the paving was laid by P. Flanigan & Sons, Inc.

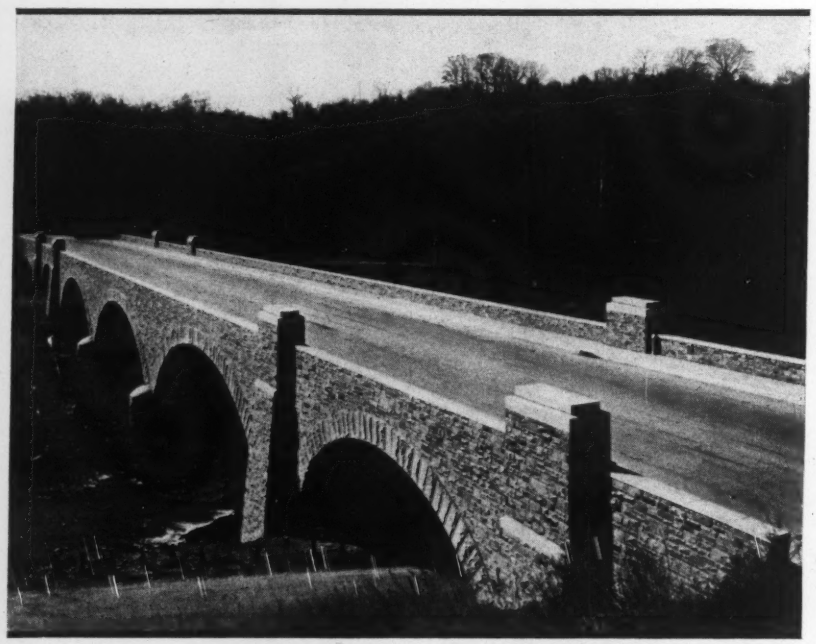
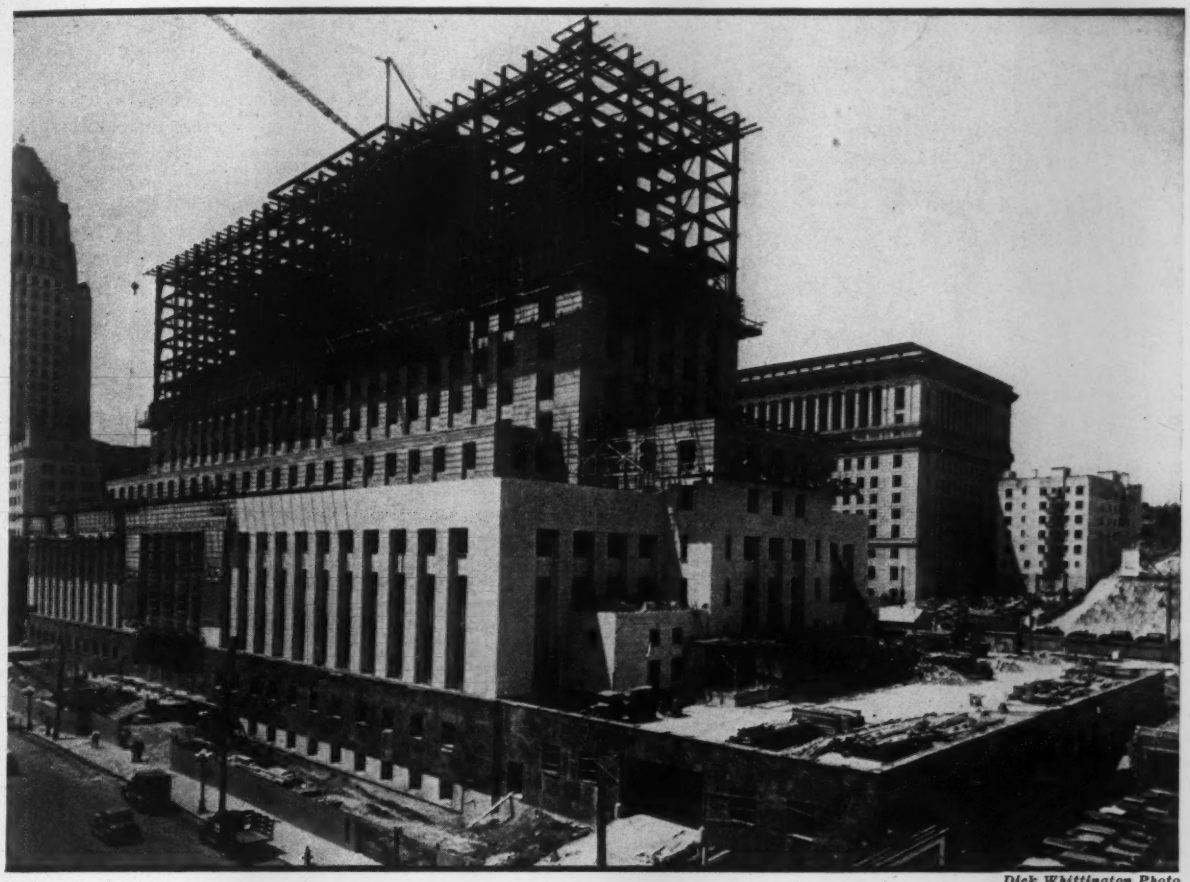


Fig. 3. Larger of the two bridges that carry Hilton Parkway over streams in Gwynns Falls valley.



Dick Whittington Photo

FIG. I. NEW POST OFFICE AND COURTHOUSE IN PROCESS OF ERECTION IN THE LOS ANGELES CIVIC CENTER AREA.

Earthquake Bracing for a Tall Building

Contents in Brief—Los Angeles federal court house and post office, rising to a height of 18 stories, benefits from a thorough earthquake-resistant design, notable for the unusual amount of heavy and deep bracing utilized in its structural steel frame. Fitting this bracing to architectural requirements required recourse to full-diagonal, K, half-story, and truss types. Two-way reinforced concrete floors serve as load-distributing diaphragms. Concrete exterior walls increase rigidity. Earthquake provisions added 4 per cent to the $7,000,000 cost of the structure.

THE NEW POST OFFICE and court house, under construction at Los Angeles, Calif., and scheduled for completion early this year, is a $7,000,000, 18-story structure, notable for the heavy bracing used in its structural steel frame and for the care taken to make connections of high rigidity. The lower floors will be occupied by the post office and the upper stories by federal court rooms and other federal government offices. The building, occupying an entire block opposite the city hall and in the area being built up as the civic center of the city, contains about 775,000 sq.ft. of net floor space (10,500,000 cu.ft.) and required 10,500 tons of structural steel, 4,200 tons of reinforcing steel and 60,000 cu.yd. of concrete. The unusual amount of bracing and the other features used to increase seismic resistance are said to have added only $280,000 (about 4 per cent) to the cost of the building.

Including the penthouse the structure is 18 stories high (about 220 ft.). The first six floors are 180x380 ft. in plan surmounted by a 12-story tower 80x330 ft. in plan. The framing is skeleton-type structural steel, fireproofed with concrete; two-way concrete floor slabs are used and the exterior walls up to the first floor are of reinforced concrete faced with granite. Above the first floor the reinforced concrete walls have a granite-texture, ceramic veneer. A one-story wing (90x180 ft.) at the north end, which encloses a low-level drive-

way, has a roof framed for 10-ton truck loads.

Earthquake resistance in the lower portion of the building is furnished by full-story and half-story diagonally braced panels; in the tower portion of the structure, portal-type bracing is used, designed with working stresses for combined seismic and gravity loads one-third greater than those generally used for gravity loads alone.

For the foundation, bell-bottomed concrete caissons were placed on stiff blue clay about 25 ft. below the basement floor. Under dead and reduced live loads the foundation loading is 8 tons per sq.ft. The caissons range from 2½ to 8 ft. in diameter and are plain concrete except at the top where, just below the basement floor, an 8-in. diagonally reinforced floor slab resting on undisturbed soil, forms a connection between the columns.

Heavy panel bracing

The bents or column lines in which seismic bracing is introduced are indicated in Fig. 3. The bent shown in elevation on this drawing is typical of those for east-west forces. Wherever possible, full-story diagonal bracing, largely of K-type, was used in the lower stories. In the ground and first stories, however, post office requirements called for clearances permitting east and west bracing only about half a story deep, with web members in the first story arranged to permit passage of galleries.

In the second and third stories necessary clearances prevented any such bracing in the center bay. In the basement advantage was taken of the floor plan arrangement to introduce a number of concrete walls, heavily reinforced to act as seismic bracing thus permitting the elimination of structural steel for bracing in this story. Details are shown below in Fig. 2.

In general, seismic loads were distributed to the bracing bents in accordance with their rigidity, using the floor slabs for the purpose and figuring them as horizontal girders.

Floors and brackets

Floor panels are generally 25 ft. square, and two-way, 8-in. floor slabs

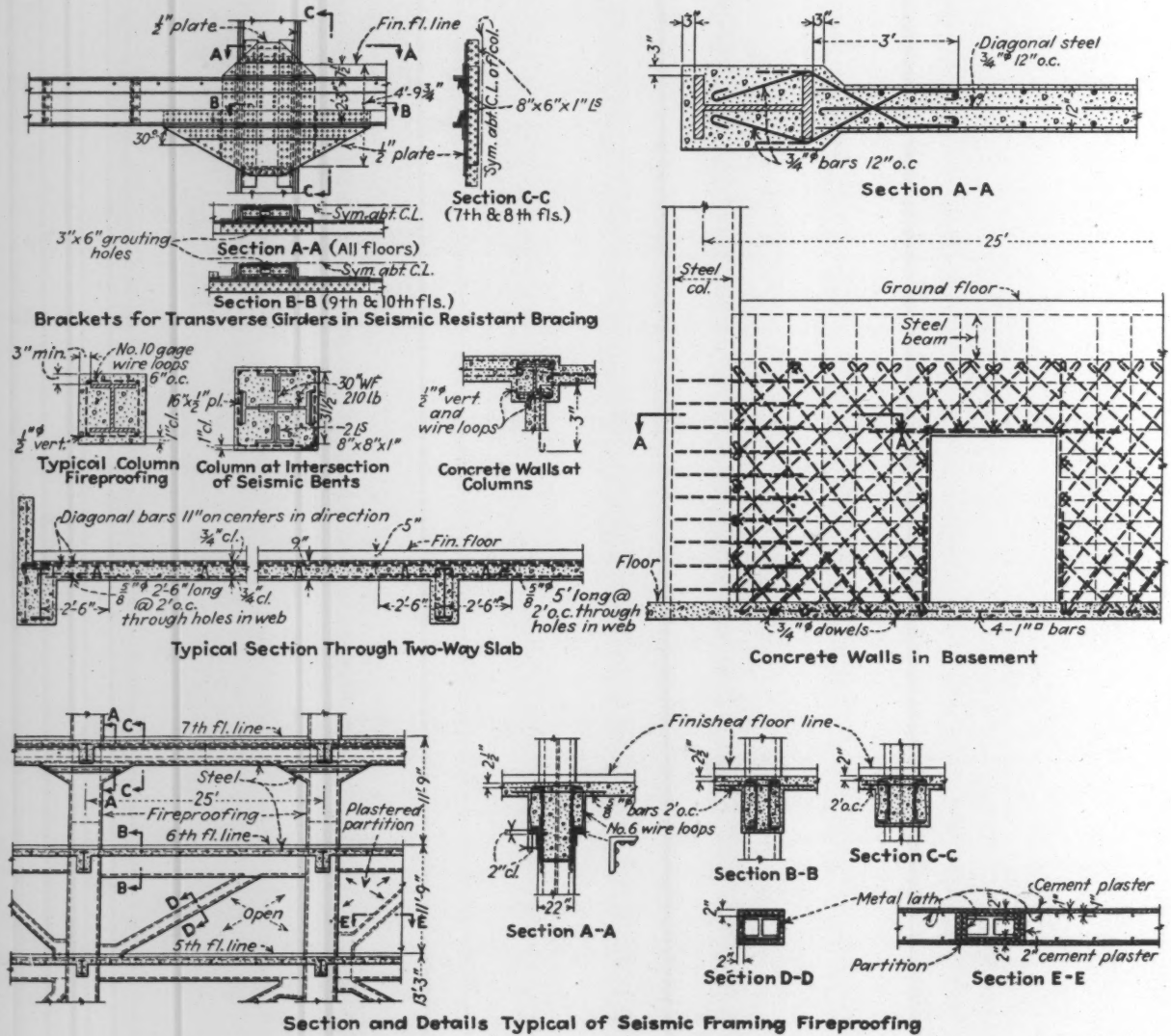

Brackets for Transverse Girders in Seismic Resistant Bracing
Section C-C (7th & 8th fls.)
Section A-A (All floors)
Section B-B (9th & 10th fls.)
Typical Column Fireproofing
Column at Intersection of Seismic Bents
Concrete Walls at Columns
Typical Section Through Two-Way Slab
Section A-A
Concrete Walls in Basement
Section and Details Typical of Seismic Framing Fireproofing
Section A-A
Section B-B
Section C-C
Section D-D
Section E-E

Fig. 2. Structural details of Los Angeles post office which were influenced by the requirement for seismic resistance.

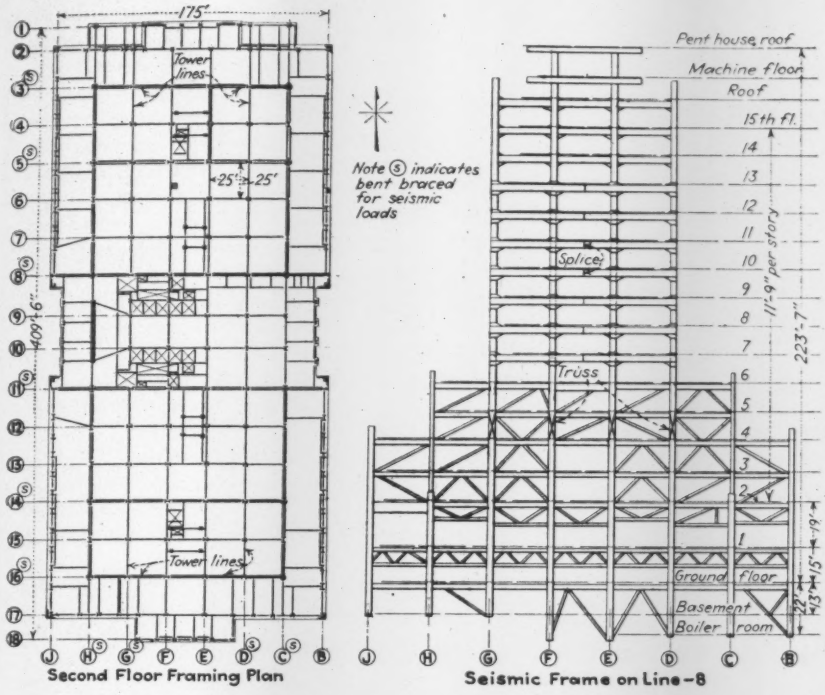


Fig. 3. Framing layout on Los Angeles post office. Bent shown in elevation is in south wall of two-story court rooms which are located on second floor.

are typical. Floors are designed for a live load of not less than 80 lb. per sq.ft. All slab rods are straight; the bottom steel, as required by the positive moment, runs normal to the supporting beams in each direction and is made partially continuous by dowels passing through the beam webs.

The top steel, however, as required by the negative moment, is placed diagonally in two directions and runs continuously over the tops of the supporting beams. Bar laps are sufficient to develop the strength of the bars where splices occur.

At intersections of seismic bents in the first story the columns consist of a combination of wide flange beams with built-up beam sections as shown in Fig. 2. Other columns in the first story on the lines of seismic bracing, but not at points of intersection, are composed of a single 30-in. wide-flange, 210-lb. section with cover plates added to flanges and web. For such of these columns as occur on and between the *D* and *G* lines, the 30-in. wide-flanged sections are required to the top of the building on account of the bending induced by the seismic forces.

As an additional factor in seismic resistance, beam-to-column connections, in addition to web connections for the vertical shear, were provided with split beams or angles at top and bottom to develop necessary moments. These connections were proportioned to develop the full strength of the column under bending and direct stress, with an allowable unit stress increase of one third. Other provisions for possible seismic effect include the use of steel stud partitions with plaster on metal lath, steel stud furring on exterior walls, concrete stair and elevator enclosing walls, steel stair and special reinforcing of the concrete exterior walls to insure as far as possible unit action with the structural steel.

Transfer trusses required

On the second floor there are eight court rooms about 50 ft. square and two stories high. Each of these rooms required two heavy, story-height transfer trusses, two bays (50 ft.) long, to pick up at the 5th floor the interrupted columns on the 4, 7, 13, and 15 lines. These trusses have chord and web members of 14-in. H sections and weigh about 35 tons each. Silicon steel was used in these trusses as well as in the heavier lower story columns.

At the sixth floor level, because of the set-back of the tower walls to the *D* and *G* lines, heavy girders extending the full length of the building were required to pick up the 12-story intermediate column loads in the exterior walls. These girders are from 4 to 5 ft. deep, some of them are of the twin-web, split-beam flange type, with several cover plates. Girder weights averaged about 8 tons each.

The concrete cover over reinforcing steel was required to have a minimum thickness of ¾ in. in slabs, 1½ in. in concrete beams, 2 in. in concrete columns and 3 in. for surfaces in contact with the earth. A 50-diameter lap was required for reinforcing bars specified as "continuous". In the structural steel frame, it was required that end connections for beams have a strength equal to the reaction produced by a uniform load stressing the beam to 20,000 lb. per sq.in. with a minimum reaction determined by a span 12 times the depth of the beam.

The building was designed by the personnel of the public buildings branch, procurement division, U. S. Treasury Department. Designing was done in the office of the supervising architect, T. C. Brooks, chief structural engineer, and Gilbert Stanley Underwood, architect. General contract was awarded to the George A. Fuller Co. of Washington, D. C.; a sub-contract for structural and reinforcing steel was held by the Consolidated Steel Corp., Ltd., of Los Angeles.

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Parking Meters Used In Many Cities

About 100 cities are using parking meters to minimize traffic congestion in their business districts, the International City Managers' Association reports. Most of the cities charge a nickel for an hour's parking. In Auburn, N. Y., however, the meters receive pennies instead of nickels. Any number of pennies up to five may be inserted at one time, each penny permitting twelve minutes parking.

Parking meters have been in court on the matter of legality eight times. They have been upheld in Oklahoma, California, Florida, Massachusetts and Texas. Alabama courts declared them illegal in two cases. A New York state law passed in 1937 permitted meters to be used anywhere in the state except in New York City, all income to be used for traffic control.

Anchored Rocks Aid River Diversion

Contents in Brief *— In building the upstream cofferdam at Ruby Dam, swift water thwarted the contractor in his attempt to block the channel by dumping in rock. This difficulty was overcome by stringing large rocks on cables anchored to the shore, thus keeping them from being swept downstream. Loose rocks were then dumped among the anchored rocks until a barrier was formed and the river was turned into the diversion tunnel.*

DIVERSION of the river into a bypass tunnel driven around the Ruby Dam site was difficult because at this point the Skagit River flows through a narrow canyon, the current is swift and the quantity of flow may double or treble on short notice. The diversion was a preliminary step in unwatering the foundation for the dam which will store floods and increase the capacity of power plants on the Skagit River. Ruby Dam is being built at the upstream end of the reservoir formed by Diablo Dam, constructed by the city of Seattle about ten years ago, and described in *ENR*, Aug. 29, 1929, p. 320. General features of the Ruby project were outlined in *ENR*, Nov. 18, 1924, p. 995.

Upon completion of the 27x32-ft. diversion tunnel around the dam site an attempt was made to divert the stream into it by building a rockfill out into the channel, beginning at a point just downstream from the tunnel portal and supplementing this advance from the right bank with rock blasted down from the precipitous wall on the left side of the canyon. This plan did not succeed because rising water carried away much of the rock blasted down. While crews waited for flow to subside, three coyote holes were driven in the rock walls and loaded with explosives. This blast, fired on a very hot day last summer when the streamflow was down to about 6,000 sec.-ft., nearly succeeded in effecting closure. However, the hot weather melted snow in the mountains so rapidly that the river speedily rose to 17,000 sec.-ft. and again swept away a major part of the newly placed fill material.

In the next attempt to close the channel, "strings of beads" were used. These were rocks of 1- to 2½-cu.yd. size, drilled and threaded on pieces of old wire rope. With one end of each cable anchored to the canyon wall, the rocks were dumped into the channel at a point whence the swift current would carry them to the desired location. After placement of a number of these "beads", a heavy blast on the opposite canyon wall brought down a large quantity of rock. The blasted fragments lodged among and against the anchored rock, effectively choked the main channel and diverted the stream into the tunnel.

After choking the channel in this way additional material was placed by trucks and bulldozers, a central sheetpiling cutoff was driven and timber cribs were used for the core of a rockfill diversion dam. The fill was made tight with clayey loam.

Another dam, put across the channel to prevent backwater from encroaching upon the site, was built of

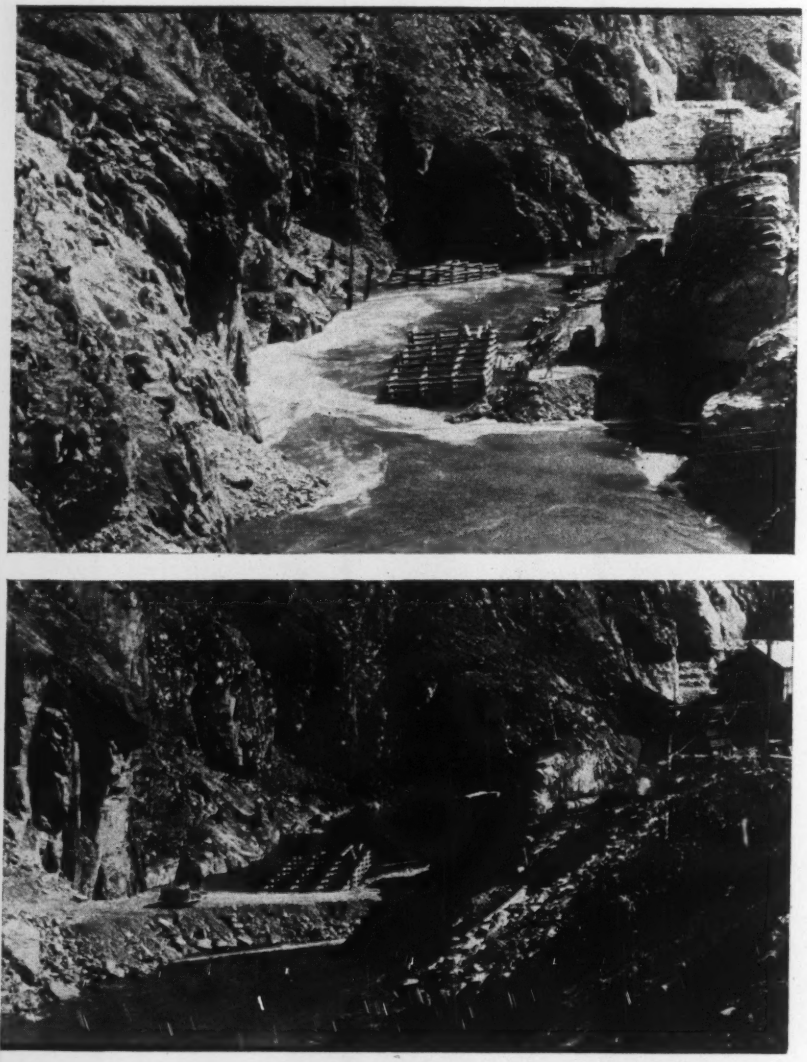

Fig. 1. Skagit River canyon showing, at the top, the end-dumping into the cofferdam, which was unsuccessful. Below is shown the closure made with the aid of anchored rocks.

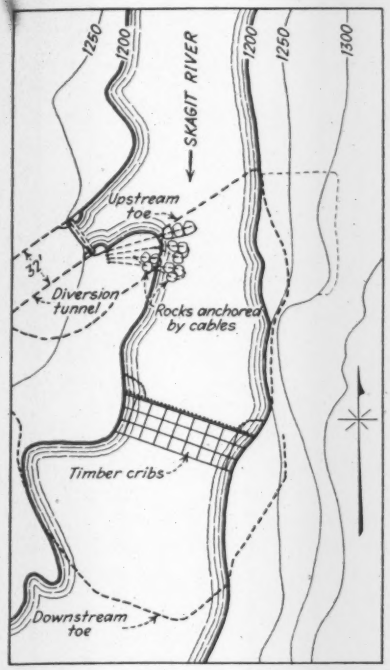

Fig. 2. Method of closing Skagit River at the site of Ruby Dam.

timber cribs faced with steel sheet-piling placed just upstream from the outlet portal of the tunnel.

The first, or foundation portion of Ruby Dam is under contract ($3,967,785) to the General-Shea-Columbia Construction Co. The dam is being built for Seattle's City Light Dept., J. D. Ross, superintendent. W. J. McKean is acting superintendent, Glen H. Smith, engineer of outside construction and W. B. Wolfendale, resident engineer on Ruby Dam. B. E. Torpen is consulting engineer.

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Many Sub-Standard Houses Found In Detroit

Results of a recently completed WPA real property survey in Detroit, Mich., show 73,688 sub-standard dwelling units out of a total of 416,960 units. The city was surveyed by census tracts. In every one of the 16 groups sub-standard houses were found. A sub-standard unit as defined by Carl L. Bradt, secretary of the Detroit Housing Commission, sponsor of the project, is one needing major repairs; it is unfit for use, has less than one toilet and one bath per living unit, no running water, no installed heating, neither gas nor electric lighting, or is occupied by more than one family.

FROM AN EDITOR'S NOTEBOOK

Travel notes made by editors on their visits to men in the field

EFFORTS to revive the Florida Ship Canal project under the guise of a needed national defense undertaking have not aroused great interest in Florida as yet, mainly because no one thinks the idea will get anywhere. Underneath, the antagonism to the deep cut across the state is as serious as ever to the south of the proposed route.

There is still the conviction that a 100-ft. cut near Ocala, in the central part of the northern half of the state, will salt up all of the vast fresh water underground reserves, which are vital to a continuation of the water supplies of much of the developed areas north of Lake Okeechobee. Proponents of the project pooh-pooh this idea. Both sides are sitting in their corners until it appears the revival may get somewhere. Then a real fight looms.

Lake Okeechobee levees

Work has been under way for some months on the revision of about 10 mi. of the 66 mi. of high levees recently completed around the rim of Lake Okeechobee to prevent recurrence of the disastrous hurricane tides which did so much damage in the past. The height is being increased for about 10 mi. along the south shore of the lake where conditions are most critical. Very flat slopes also are being added for several miles on the water side to prevent toe erosion from the heavy wave action set up on the shallow lake.

Water supply problems

Along the east shore of Florida, south from about two-thirds of the way down the state, the municipalities face a water supply problem that now is to receive the collective attention it deserves. Most of the rapidly growing cities and towns in that section take their water from underground sources. Miami, typically, has had to retreat inland with its wells as the old supplies became brackish with lowered groundwater levels.

An appropriation of $150,000 has been made by the federal government, to be available for a comprehensive survey of the situation, when matched by Florida funds. Meantime, there is much division of opinion among local engineers as to the right solution.

Overseas highway

Traffic over the recently opened Overseas Highway between the mainland and Key West, 90 mi. offshore, has been surprisingly heavy since the tourist season got into full swing. This unusual undertaking, which has several long bridges that are decked over the original Florida East Coast Railroad structures, did not do much business for a time after it was opened last summer. The tourists have found it now, however, as one of those "farthest" objectives the American motorist enjoys so well. Key West also has a lure to those who are looking for the unusual. So the toll from the project bids fair soon to make it possible to finance reconstruction of another 40 mi. of the abandoned railroad to replace sections of old state highway nearer Key West that are not so good.

Key West water problem

Key West has always found its roof water ample to take care of the drinking water needs of its population. Salt water is used for all other domestic purposes. But the great influx of tourists has introduced a new situation; the roof water will not go around.

The nearest known supply of fresh water is on the mainland at Homestead, 140 mi. away. In between are practically uninhabited keys, which also need water, if they are to be developed.

Nebulous plans are being revived for a pipe line from Homestead across the keys to Key West. The cost of this is variously estimated. It would run at least $3,500,000, according to competent Florida engineers. Key West finances do not permit of any substantial contribution. But with water selling at 2½c. a gallon, there are possibilities of raising the necessary money.—S. T. H.

Tests of Large Riveted Joints

Contents in Brief—An extensive series of tests on large riveted joints was reported at the recent American Society of Civil Engineers meeting in New York by Professors Raymond E. Davis and Harmer E. Davis of the University of California and Glenn B. Woodruff, engineer of design, San Francisco-Oakland Bay Bridge. In the abstract of their paper that follows it is indicated that the usual assumption of equal distribution of load among rivets is satisfactory regardless of the length of the joint; and that nothing is gained by omitting rivets in the end row to increase the net section.

SPECIFICATIONS commonly employed in the design of structural riveted connections are based largely on tests made at Cornell University in 1904, on joints of relatively small size having a maximum of nine rivets in either end and made of softer plate and rivet steel than now used. Some joints fabricated with nickel steel plates and rivets were tested at the University of Illinois in 1911, but these joints also had no more than nine rivets in either end of the joint. A test program recently carried out at the University of California and financed by San Francisco-Oakland Bay Bridge funds is, therefore, the first involving large and long structural joints.

Of the forty joints tested (in static tension), 18 were of lap type, designed to fail in the joint, 16 of lap type, designed to fail in the plate, while 6 butt and shingle joints were also included. Plate steel used was carbon, manganese and nickel, and rivet steel was carbon and manganese. Joints containing as many as 28 transverse rows of rivets were included among the specimens.

Rivet strength

On the subject of rivet strength, i.e., the average shearing resistance of the rivets in a joint, the following conclusions are drawn from the tests.

Length of Joint—Although rivet strength declined with increase in length of joint, such variation (on the order of 10 per cent for 6 ft. as compared with 1½-ft. joints) is not important compared with variations arising from fabrication inequalities.

Rivet Pitch—The effect of the pitch between the transverse rivet rows was small, although a 4½-in. pitch (4½ rivet diameters) gave slightly better efficiency than either the 3-in. or the 6-in. pitch.

Kind of Rivet Steel—The manganese steel rivets performed somewhat better than the carbon-steel rivets. The average ratio of rivet strength to rivet working stress was found to be 3.73 for manganese steel rivets as compared with 3.52 for carbon steel rivets.

Plate Steel—In the joints which failed in the rivets, the effect of kind of plate steel was neither large nor consistent. However, there was less tendency for premature failure of end rivets with the less ductile plate steels.

Single vs. Double Shear—Indications are that the strength of a rivet surface in double shear may be as low as 80 per cent of the strength in single shear.

Net section

An outstanding finding of the tests is that the strength of the plates in a riveted joint is not directly proportional to the area of the net section as commonly assumed in practice. The tests indicated that the use of fewer rivets in the end rows than in interior rows is ineffective. Wide spacing of end row rivets (near the edges of the plate) is especially undesirable since differential lateral contraction of the opposing plates at each end of the joint subjects such rivets to lateral strain which, combined with the longitudinal strain, causes premature failures of these rivets. In tests of joints having the full number of rivets in the end row, the efficiency was about 10 per cent higher for a 4-dia. than for a 3-dia. spacing.

Regardless of the number of rivets in the end row, the net section taken at the row having the greatest number of rivets correlated better with the observed strengths in these tests than did the net section computed by standard specifications. Nothing, therefore, is gained by using an elaborate formula to evaluate the effect of pitch on net section for joints of the type tested.

Butt vs. shingle splices

Little difference in efficiency between the butt and shingle splices was indicated. The partition of load between the splice plates, as determined by the tests, agreed fairly well with the usual assumptions used in designing such splices.

Slip

The ratio of slip measured near the ends of joints to slip at the middle of the length of a lap became a constant when the rivets came into full bearing. This ratio was a function of the length of the joint. In one of the series of tests, joints containing carbon steel rivets exhibited markedly less slip than those containing two-thirds as many manganese steel rivets. As between the various series of tests, the slip was less for joints with full-row riveting than for joints with any other rivet pattern.

Partition of load

In general, although the test results indicated that the partition of stress among rivet rows is not uniform at any stage of loading, in view of the probable inequalities of fabrication, it is believed that the usual design assumption of uniform partition is as reasonable as any that can be made.

Design recommendations

From the results of these tests, together with those of other investigators, the authors of the paper offer the following statements relative to practice in the design of riveted joints for bridge construction:

(1) Nothing is gained by an attempt to detail a tension member with a critical net area greater than about 75 per cent of the gross area.

(2) There is no justification for elaborate formulas to calculate the effect of rivet stagger on net section.

(3) Joints should be as compact as practicable. Optimum results will probably be obtained by full-row riveting with a gage of about 4½ rivet diameters and a pitch of 3½ to 4 rivet diameters.

(4) Statements 1 to 3 lead to the suggestion that the allowable loads on riveted tension members be based on, and expressed in terms of, stress in the gross section; and that the net section be not less than 75 per cent of the gross section.

(5) In view of the uncertainty as to the actual stress distribution in commercially fabricated joints, the practice of assuming equal shear per rivet, regardless of length of joint, is satisfactory.

(6) Except in comparatively heavy structures, where reduction in size or weight of splice is important, there is little reason for using manganese-steel rather than carbon-steel rivets. Owing to the greater slip that occurs in joints with manganese-steel rivets, carbon-steel rivets are preferable in members subjected to stress reversals.

(7) Working stresses for manganese steel rivets as compared with those for carbon steel rivets should be lower than their relative ultimate strengths would seem to indicate because of the greater slip that occurs in joints containing manganese steel rivets.

New Deformeter Apparatus

WILLIAM J. ENEY

Assistant Professor of Civil Engineering
Lehigh University, Bethlehem, Pa.

Simplicity and low cost characterize equipment for measuring deformations in structural models

THOSE who are acquainted with the mechanical devices for the stress analysis of indeterminate structures appreciate the inherent advantages of the sheet model introduced by Prof. Beggs as part of his deformeter method. Wishing to preserve these advantages but desiring a relatively simple and inexpensive manner in which to induce and measure the deformations, the writer, several years ago, developed a deformeter apparatus suitable for everyday use.

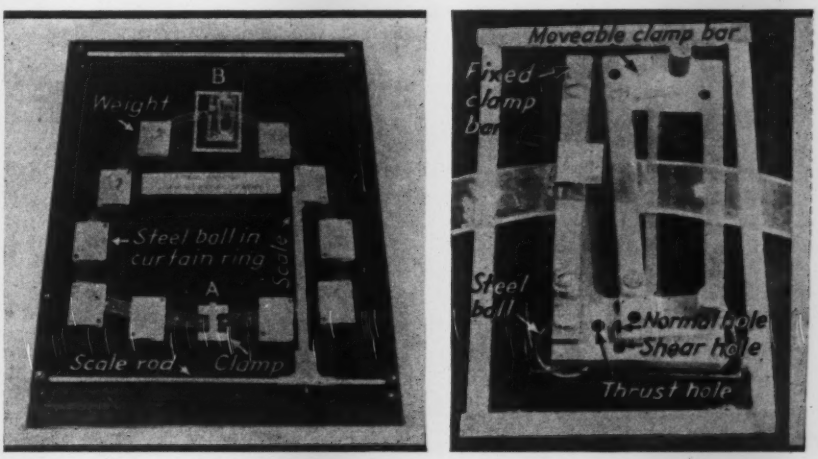
One type of this deformeter apparatus is shown here in use in a stress analysis of a semi-elliptical sewer section. The results obtained agree with the analytical solution presented by C. D. Williams in *E. N. R.* Feb. 23, 1933, p. 242. In that analysis, the backfill load and ground reaction were assumed to be carried by six crown voussoirs and twelve base voussoirs respectively. Due to symmetry of loading and section, the tangents to the elastic curve at points *A* and *B*, remain horizontal after load, and there is zero horizontal movement of points *A* and *B*. The model, therefore, can be rigidly fixed to a drawing board at point *A* and, by introducing deformations with a gauge in the severed model at point *B*, the crown moment and thrust necessary for the analysis are determined. A feature of the method is that relatively large deformations are used.

The voussoir centers are shown as white celluloid targets on the celluloid model. The net displacement of these targets accompanying deformations induced by the gage are measured with a scale oriented in the direction of the loads acting on the prototype. This scale, graduated in 100 divisions per in. is easily read with a watchmaker's loupe to an accuracy of 0.002 in. Parallax in the scale readings is avoided by using targets made by scratching a sharp cross on small mirrors.

In the illustrations a pure rotation of 0.100 radians is being introduced by a gage. An equal but opposite rotation is next introduced, thereby eliminating from the net displacements of the targets the effect of geometric errors otherwise resulting from the use of large gage deformations. Dividing each target displacement by the total rotation, 0.200 radians, and multiplying by the linear scale ratio of the model gives the influence ordinate for moment at point B. The sign of the moment is evident from the visible displacement of the model.

The influence ordinates for thrust are obtained by first increasing the distance between the clamping bars 0.250 in. and then decreasing it 0.250 in., a total of 0.500 in., in such a manner that the bars, and hence the cut edges of the model, are parallel to each other. Furthermore, no translation of the bars relative to each other in the direction parallel to the vertical center line *AB*, i.e., shear displacement, is permitted. These deformations are controlled by a pattern of holes in the gage as shown. The net displacement of each target, when divided by the induced gage deformation of 0.500 in., gives the influence ordinates for thrust at point *B*.

With large gage deformations, errors due to normal temperature deformations in the model are negligible. Because of its simplicity, the apparatus used with a celluloid or special cardboard model is particularly adapted for the designer in a drafting room who is interested in quick reliable results.



Deformeter apparatus, which induces relatively large deformations in models, shown mounted on a celluloid sewer section. At right, an enlarged view of the apparatus.

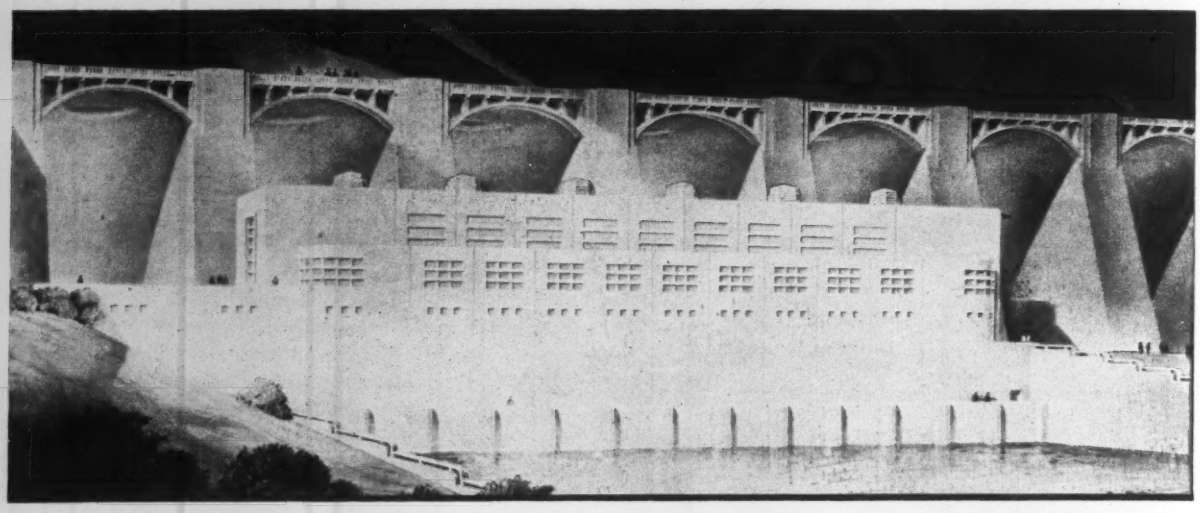


FIG. I. PENSACOLA DAM IN OKLAHOMA IS TO BE A MULTIPLE-ARCH STRUCTURE WITH HOLLOW BUTTRESSES

Pensacola Dam Gets Under Way

W. R. HOLWAY

Holway & Neuffer, Consulting Engineers, Tulsa, Okla.

Contents in Brief—Work has begun on a combination power and flood control dam on the Grand River at Pensacola, Okla. It is to be a multiple-arch structure 152 ft. high flanked by a long concrete spillway and non-overflow sections. A power house is to be built in the river channel below the dam. Included in the work is a considerable amount of highway and railway location. Principal details of the structures are given as are the main contracts let to date.

FOR TWENTY YEARS various private interests have considered a hydro-electric plant at the Pensacola site on Grand River in northeastern Oklahoma, where limestone and chert cliffs rise 150 ft. above the river on the west side and wooded hills line the mile-wide valley on the east. Today a high, multiple-arch concrete dam is being built across the broad valley, part of an extensive power and flood-control project that includes two auxiliary spillways, and considerable highway and railroad relocation. In 1935 the Oklahoma legislature created the Grand River Dam Authority, "a public corporation and state instrumentality created, organized, and existing as a conservation and reclamation district," acting through a board of nine directors appointed from a district comprising fourteen counties. The authority has the power to issue bonds to be repaid with the revenue from the sale of electric power. It can build dams on the Grand River to "provide water storage for the purpose of flood control and of hydro-electric developments." In 1936-37, the U. S. Army Engineers made underground investigations at the Pensacola site and surveyed the reservoir area. The Pensacola Dam and two other lower dams further down the river were recommended for construction as flood control and power projects.

The Grand River Authority received a PWA loan and grant of $20,000,000 in September, 1937, for construction of the Pensacola Dam. The authority immediately selected engineers, counsel, and a manager, and preparation of plans was pushed to permit early starting of work. On June 17, 1938, the authority received bids on three major contracts for the work, four preliminary contracts having been previously let and work begun. The preliminary work consists of excavation for auxiliary spillways, 1 mi. east of the main structure, the core drilling at the dam, construction of a 4-mi. railroad leading to the site, a highway and bridge across the river a half-mile below the dam, and the 66,000-volt transmission line to bring power

PRINCIPAL CONTRACTS

1.	Excavation of East Spillway, M. E. Gillioz, Monett, Mo.	$91,317
2.	Core Drilling, Sprague and Henwood, Scranton, Pa.	33,968
3.	Construction Railroad, Highway, and Bridge Leo Sanders, Oklahoma City, Okla.	153,300
4.	Electric Transmission Line B. & M. Construction Corp., Oklahoma City	35,936
5.	Turbines, Governors, and Valves Allis-Chalmers Mfg. Co.	659,650
6.	Electric Generators Westinghouse Mfg. Co.	679,110
7.	Dam, Power House, Installation of Turbines Massman Construction Co., Kansas City, Mo.	9,322,960
8.	Grove Highway Bridge (est.)	349,820
9.	Frisco Railroad—Track Elevation (est.)	550,000
10.	Relocation of the K. O. & G. R. R. (est.)	365,000
	Total	$12,241,061

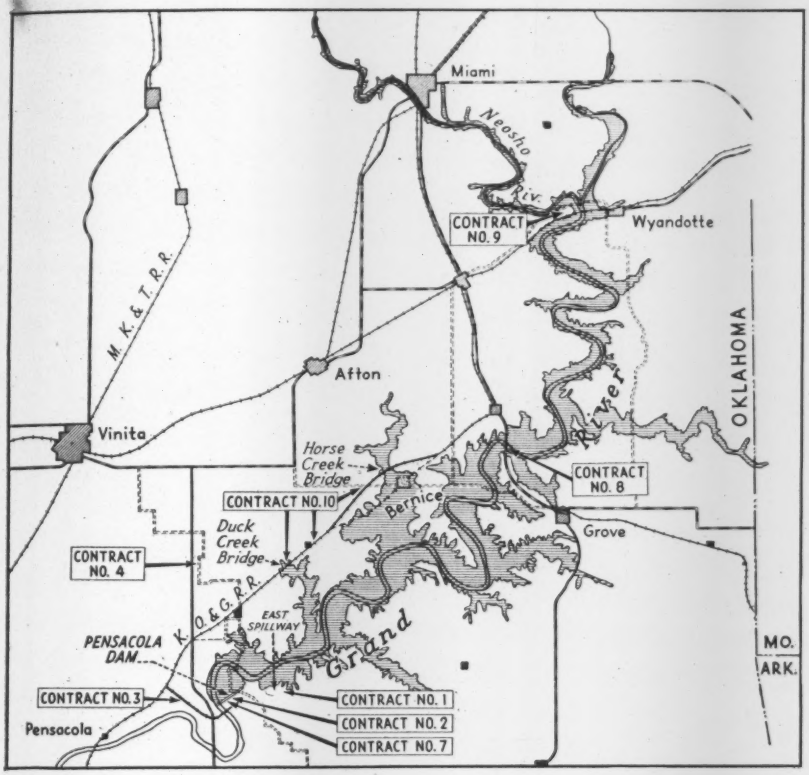


Fig. 2. Site map of the Pensacola Dam, Grand River Project, showing the numerous railroad and highway relocations involved.

to the site from Vinita, 16 mi. away. This line will later serve as one of the permanent lines to transmit power from the dam.

Main contracts

The three major contracts include: furnishing of four 20,000-hp. turbines, awarded to the Allis-Chalmers Mfg. Co.; furnishing and installing four 16,000-kva generators, let to the Westinghouse Electric & Manufacturing Co.; construction of a dam and power house, installation of turbines and erection of gates on the spillways, awarded to the Massman Construction Co. of Kansas City.

Nine bids were received on the dam and power house, from contractors all over the country, and the contract, $20,000 under the engineer's estimate, was the largest ever to be let for public work in Oklahoma. The performance bond, which by state law, must be 100 per cent of the contract price, is believed to be the largest ever written in the United States, $9,500,000, executed by eighteen surety companies.

Underground investigations made by the army engineers and the engineers for the authority, revealed a foundation of limestone 75 ft. thick overlying 50 ft. of shale, extending for the full length of the dam. Studies of various types of dams showed that a reinforced concrete multiple-arch type most economical for this site.

The dam is to be 152 ft. high above river bed and will be made up of 51 arch sections of 60-ft. span between hollow buttresses, each of which is to be 21 ft. wide. There will be 860 ft. of main gravity ogee spillway section and 450 ft. of concrete gravity non-overflow section at the east end. In addition to the spillway section in the main dam, two auxiliary spillways, aggregating 860 ft. long, are located about a mile east of the main structure. A 20-ft. wide highway will extend the entire length of the main dam and the spillways, supported on buttresses of the dam and on piers over the spillway sections.

The crest of the main spillway (El. 730) will carry radial gates 37 ft. wide and 25 ft. high. The east spillway, with crest at El. 740, will be provided with similar gates 37 ft. wide and 15 ft. high. All spillway sections are provided with stop logs. Two motor-driven gate hoists of 60 tons capacity each will be installed to lift the gates and stop logs of the main spillway and two 30-ton capacity hoists will be used at the east spillway.

Four 15-ft. steel penstocks will conduct water to the main turbines, each equipped with a 15-ft. butterfly valve.

The power house is to be built immediately below the dam at the west side of the channel. Four 20,000-hp. hydraulic turbines will be installed initially for the main units and one

Fig. 3. Uniform flat ledge provides an ideal foundation for the high multiple-arch dam. This view, taken from the high right-bank bluff, shows the first cofferdam in place; the river lies just below the bluff.

750-hp. house unit. The four main generators are of 16,000-kva. capacity. Space is provided in the power house for two more similar units.

Above the dam, the Grand River has a drainage area of 10,415 sq.mi. Records going back 12 yr. indicate a maximum run-off of 10,600,000 acre-ft. per year, and a maximum daily discharge of 135,000 sec.-ft. The maximum flood, in 1895, is estimated at 220,000 sec.-ft. The spillways of the Pensacola Dam will have a total capacity of 525,000 sec.-ft. Normal pool level will be at El. 745; high water level at El. 750. At El. 745 the lake area will be 46,500 acres and the storage capacity will be 1,680,000 acre-ft.

Relocations

Maximum high water at El. 750 necessitates the raising of 4½ mi. of the main line of the Frisco R. R. near Wyandotte, Okla. The elevated track will parallel the main line and will include a new bridge over the river. It is also necessary to relocate 7½ mi. of the K.O.&G.R.R. near Berenice, Okla., and to build a new bridge over Horse Creek for the new line. The authority is also preparing to build a new steel and concrete highway bridge 2,500 ft. long over the reservoir, high enough to clear the masts of sailboats. This bridge will be 3 mi. northeast of Grove, Okla.

The main quantities involved in the construction of the dam and power house are as follows:

Earth excavation	1,300,000 cu.yd.
Rock excavation	190,000 cu.yd.
Cement	580,000 bbl.
Reinforcing	18,640,000 lb.
Concrete	475,000 cu.yd.
Structural steel	5,870,000 lb.

R. V. L. Wright is general manager of the Grand River Authority. Holway & Neuffer, Tulsa, as engineers for the authority prepared the plans and are in charge of construction. Barry Dibble, Redlands, Calif., is consultant on hydroelectrical installations; Victor H. Cochrane, Tulsa, is on structural design; D. A. MacCrea, Little Rock, is on railroad relocation; Prof. Kirk Bryan, Harvard, is consulting geologist; and John Duncan Forsyth, Tulsa, is consulting architect. E. L. Chandler, is chief construction engineer on all contracts, and H. H. Ferguson is project engineer for the PWA.

FIG. I. THE SPILLWAY AT OTTER CREEK DAM IS THROUGH A ROCK CHANNEL.

Snyder, Okla., Goes to the Hills For a Surface Water Supply

F. M. HIERONYMUS
Resident Engineer, Holway & Neuffer, Tulsa, Okla.

Contents in Brief—Periodic failure of its well supply led Snyder, Okla., to go to the hills for a surface water supply after deepening of the wells did not meet current needs during dry years. The new supply, including a filtration plant, cost slightly over $100 per capita.

A RESOURCEFUL METHOD of meeting the water supply needs of a small town located in a region often without rainfall for many months is illustrated by the recent action of Snyder, Okla., in going to the mountains for water. Snyder, with its population of 1,200 persons is located in extreme southwestern Oklahoma where importation of water in tank cars is not unusual. Three new water supply wells, which were purchased as a cure-all in 1936 for $15,000 and failed in 1937, did not constitute a new experience—thirty-five years of drilling wells into the semi-arid prairie for a dependable water supply (even though it was abnormally hard and bitter-tasting due to its gypsum content) had been filled with disappointments.

Snyder had almost resigned itself to the trying conditions of water rationing because procurement of a never failing supply of good water seemed too costly for such a small town to undertake. Given new hope by the prospect of government aid through PWA, engineers for the town studied the possibility of impounding surface runoff in an uncontaminated mountain region. Construction started in December, 1937, and six months later a dependable soft water supply was turned into the mains.

The new $125,000 system consists of an earth dam storing runoff from the headwaters of Otter Creek in the weathered and bare granite Wichita mountains northwest of town. From a concrete intake in the reservoir, water flows to the 0.36-m.g.d. filter plant which is ¼ mi. below the dam. Alum and lime prepare it for passage through two filters. Chlorine is then added. Two 250-g.p.m. centrifugal pumps, electrically driven, lift the filtered water to a 50,000-gal. concrete storage reservoir on a nearby mountain. This reservoir provides head for gravity flow through 6 mi. of 8-in. welded steel pipe to a second concrete storage reservoir in the town. An automatic float valve maintains the level in the latter reservoir from which the water is lifted 120 ft. by a centrifugal pump into an existing 80,000-gal. steel pressure tank which feeds the distribution system.

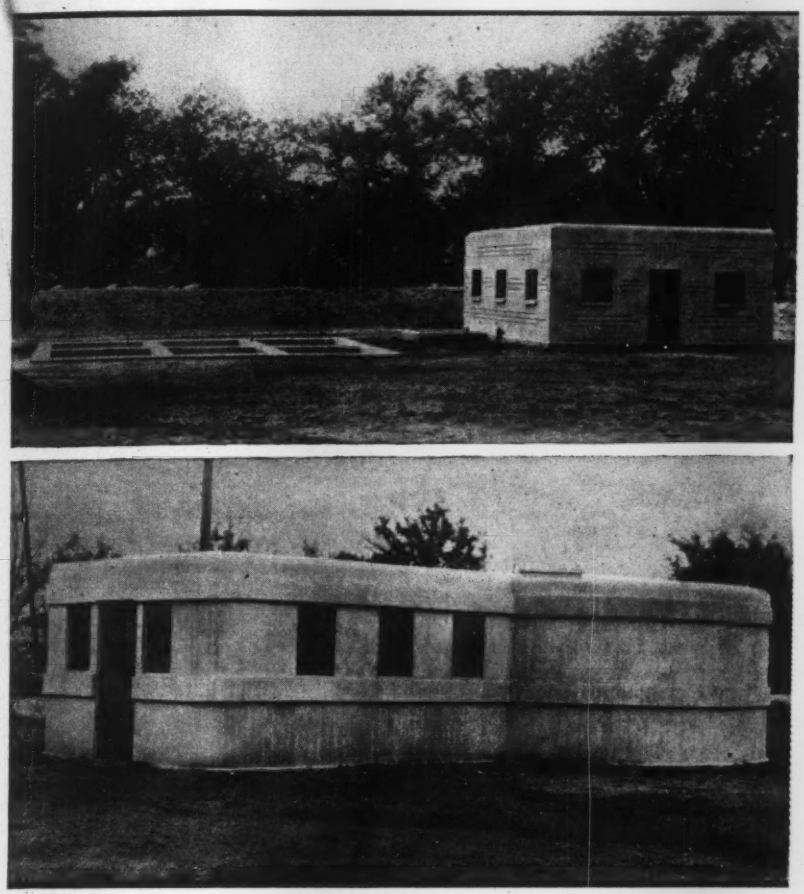


Fig. 2. Filter plant, pump station and settling plant (above) protected by a dike, and (below) the combined concrete reservoir and pump station in the town.

The pump is started and stopped by a float-operated electric switch. Auxiliary pressure for an emergency is provided by a gasoline-driven fire pump of 500-g.p.m. capacity.

Design of dam

The dam required 36,000 cu.yd. of compacted earth, riprapped on both slopes with 3 ft. of granite from the 9,000 cu.yd. of spillway channel blasted from the hillside. The 250-ft. uncontrolled spillway crest is 14 ft. below the top of the dam and estimated to carry flood flows from the 125-sq.mi. watershed. The spillway level is maintained across the lower slope of the hillside for a distance of 1255 ft. from the end of the dam by constructing a granite masonry weir, securely keyed into the natural rock at its base. The remaining 125 ft. was cleaned off carefully down to solid rock and filled in with mortar and small rocks up to the weir level to prevent leakage below the desired grade. The retaining wall at the junction of the weir and the dam was built of massive granite boulders placed in a full bed of mortar and keyed into the native ledge rock at its base. It is 125 ft. long, 15 ft. thick at its base, and rises 14 ft. above the weir crest.

The dam is located at the lower end of a narrow passage, 4,000 ft. long and 300 ft. wide, through perpendicular granite bluffs. Upstream from this passage normally-dry Otter Creek divides into two deep channels with steep banks. Most of the 120-acre lake surface is in this deep canyon and in consequence evaporation is minimized. Of the 1,330-acre-ft. total storage more than 800 acre-ft. is available. The watershed with its 21-in. average precipitation (lowest recorded is 10 in.) provides ample runoff for years to come, since the present annual consumption of the town requires a runoff of less than 0.1 in. depth from the 125-sq. mi. watershed.

The engineers were Holway & Neuffer of Tulsa, Okla., for whom W. W. Wheeler was designing engineer and the writer resident engineer. J. J. Tibey was resident engineer inspector for PWA. Moran & Buckner of Muskogee, Okla., were the contractors.

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Chemical Hazards at Waterworks Plants

Hazards involved in the handling of chemicals at waterworks plants have been reported to the American Water Works Association by its committee on waterworks practice, the reports being prepared by a subcommittee on chemical hazards. Two earlier reports have covered chlorine and ammonia, while a third report (1938) deals with sulphur dioxide and caustic soda. This report also refers to former resolutions for the elimination of fusible plugs from chlorine containers of a ton (or less) capacity. The U. S. Bureau of Explosives has requested the Chlorine Institute to consider the matter, and though no action has been taken, the committee feels that its objective will be accomplished in eliminating accidents due to fusible plugs as they were being used in these containers.

Liquid sulphur dioxide, in cylinder containers, is classed as a non-explosive, non-inflammable compressed gas, and is commonly shipped in steel cylinders of 5- to 150-lb. capacity. A fusible plug below the valve seat should soften at 157 deg. F. and positively relieve at 165 F. Dry sulphur dioxide is not corrosive to common metals, but in contact with moisture it forms sulphuric acid, which is corrosive to piping and valves. The cylinders are safe when properly used, but serious accidents may result from careless or ignorant handling. Appliances are available for moving and inverting the containers. Gas masks should be kept readily accessible, and first aid methods are outlined in the report.

Caustic soda is sold in solid, flake and liquid form. The first is shipped in steel drums of 700 to 760 lb. capacity, and the second in drums of 25 to 500 lb. Liquid caustic soda is delivered in tank cars of 6,000- to 10,000-lb. capacity, having pipe coils for steam to melt the soda if frozen. Precautions are necessary for safe handling.

Long Span Tied Arch in Elevated Highway

J. M. FRIEDLAND

Department of Borough Works, Borough of Manhattan, New York

Contents in Brief—Extension southward of New York City's West Side Elevated Highway is featured by a 360-ft. span tied-arch over the Canal St. intersection. Foundations had to be sunk to miss the Holland Tunnel which passes under the site. A solid rib arch is used to conform esthetically with the adjacent plate girder viaduct. Multiple-plate ties adhere to this conformity, but are also used to secure a more even stress distribution than is possible with pinned eyebars. Rolled-section hangers are joined to the rib diaphragms by angles, giving a flexible connection without recourse to pins.

UNUSUAL for its location—spanning a city street—and interesting structurally—because of its extreme width, its rib, hanger and tie details and its difficult foundations—the tied-arch crossing of Canal St. in New York City's West Side Elevated Highway, opened to traffic last week, is a conspicuous addition to the Hudson River waterfront skyline. Departure at this location from the plate girder viaduct design used elsewhere in the highway was dictated by foundation conditions and by the desirability of eliminating columns from the busy Canal-West St. intersection. Foundation conditions narrowed the selection of type to a truss or tied arch, and esthetic considerations suggested the latter type, using a solid rib arch that would merge into the plate girder approaches with a minimum of contrast.

Foundations

The bridge, of 360-ft. span and providing for three lanes of divided traffic each way, is 82 ft. wide between ribs. Foundations consist of narrow piers, 7x34 ft., for each arch bearing. The two at the south end rest on reinforced concrete mats joined transversely by a 3x6-ft. reinforced concrete tie beneath the street and supported on 18-in. concrete-filled steel tube piles driven to refusal for a design load of 100 tons each. For the two north piers, located over and between the Holland Tunnels, it was considered inadvisable to drive piles, and each pier, therefore, is supported on two concrete-filled steel shells, of 10- and 9-ft. diameter respectively and 16 ft. center to center in a north-south direction, sunk 90 ft. to rock under compressed air. The four shafts of the north foundation are tied together transversely by a concrete K-brace.

Each abutment pier takes the bridge reaction at one end and the reaction of a long girder span at the other end. To take care of inequalities in live load reactions, the abutments are reinforced for shear and moment.

Principal structural elements

The bridge is built entirely of carbon steel. The parabolic ribs with a span of 360 ft. and a rise of 61 ft. 6 in. are of H-section, 7 and 9 ft. deep at the crown and abutments respectively. Each tension tie consists of two sets of five plates, each set having an aggregate section of 36x3$\frac{1}{8}$ in. The tie is given a camber of 18 in., making the structure equivalent to an arch with a rise of 60 ft., or one-sixth of the span. The multiple-plate tension tie, with the plates in the planes of the webs of the arch rib and being in fact integral with them at the ends, gives a far more even distribution of stress than groups of eyebars and pins, and is much more pleasing in appearance.

The tie and the floorbeams are independently supported every 20 ft. by I-beam hangers, the webs of which are placed parallel to the axis of the bridge to minimize secondary stresses due to sway. At the upper ends, groups of 4 angles connect the webs of the hangers to diaphragms in the arch rib, giving a flexible connection without recourse to pins. Floorbeams, 81 ft. 10 in. long, are spaced 20 ft. apart. They are 7 ft. deep at the

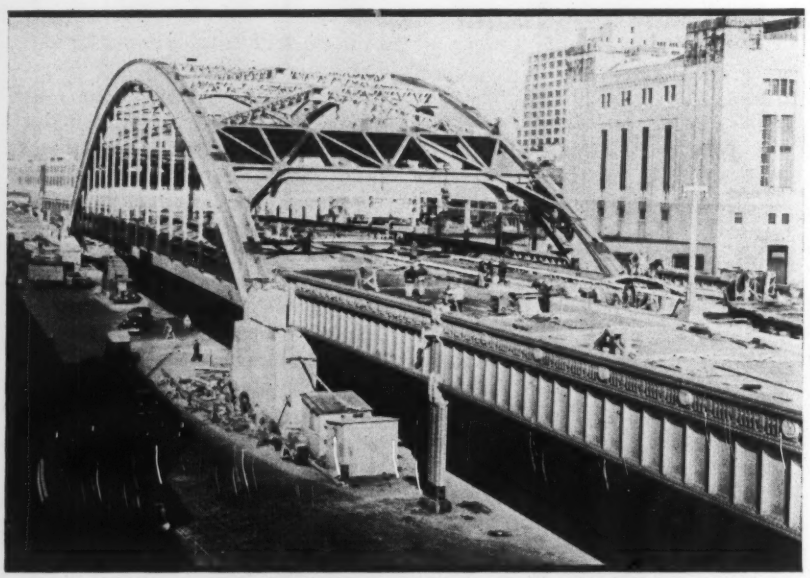

Fig. 1. New York's elevated highway, elsewhere a viaduct structure, crosses Canal St. on a 360-ft. span tied arch. Holland Tunnel ventilation building at right.

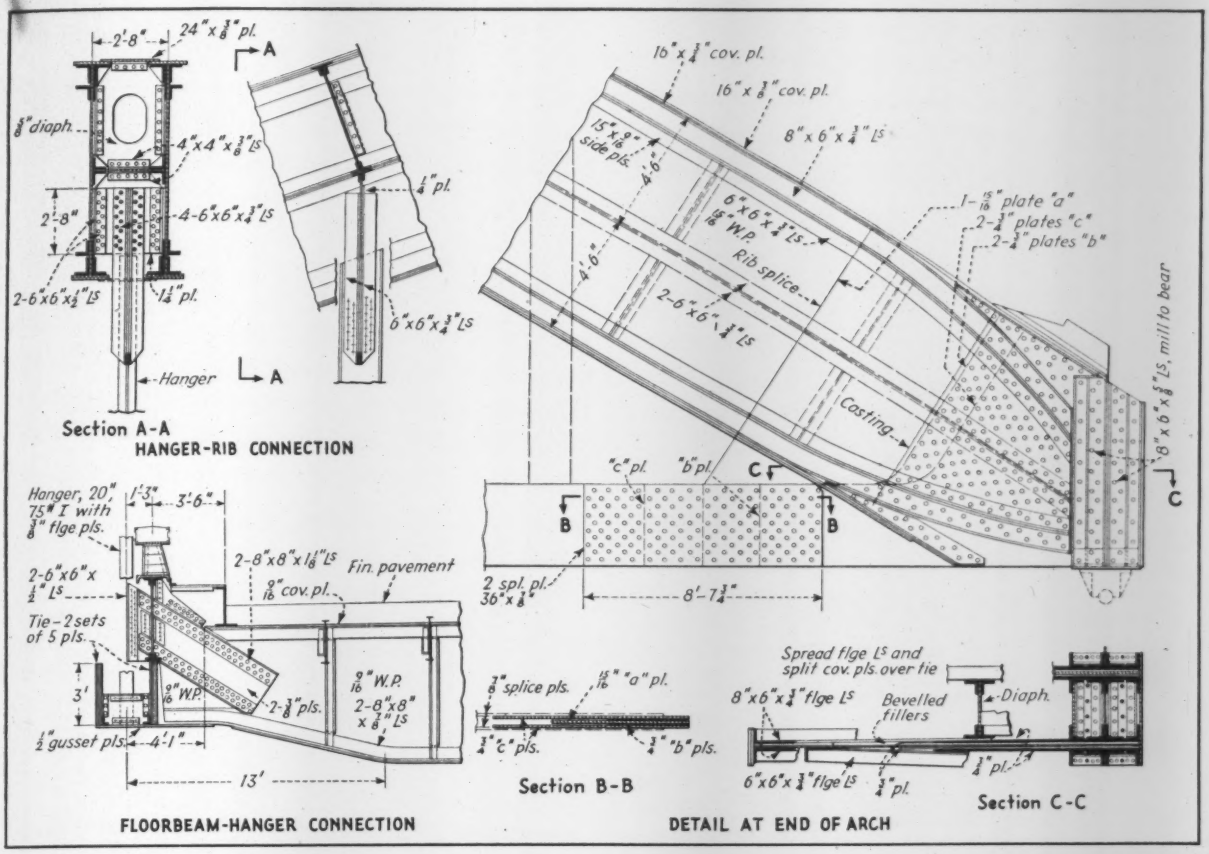

Fig. 2. Noteworthy structural details in Canal St. bridge occur at tie-and-rib connection and at connections of hangers to rib and floorbeams. Tie of multiple plates permits compact riveted connection to ribs without recourse to pins.

center and weigh 26 tons each. Stringers, 24-in. 78.8-lb. I's, spaced 5 ft. apart, are provided with sliding supports on the floorbeams at every second panel point to prevent the floor system from affecting the arch stresses.

The end reactions of the arch are carried through 6-in. pins to a cast steel pedestal on a grillage at the north end, and to a cast steel pedestal on a nest of nine segmental rollers, 12 in. in diameter and 4 ft. long, at the south or expansion end.

A K-system of latticed box members, with channel and angle lacing, touching the chord every 40 ft. at alternate hanger points, is used for the upper lateral bracing, while the portal bracing consists of two deep plate girders 20 ft. apart opposite hangers 2 and 3. These portal girders provide almost all of the sway resistance since the K-system is relatively flexible. Being placed radially near the ends of the arch where the rib itself is both deep and rigid, the portal girders resist sway without high secondary and torsional stresses in the upper parts of the arch. To minimize lateral bending moments in the ends of the arch rib, knee struts are extended below the lower portal girder as far down along the rib as headroom allows. The lower lateral bracing is a double-intersection web system of 8x8-in. angles figured to take tension only, while the floorbeams act as the compression members and the arch ties as chords in the horizontal truss system.

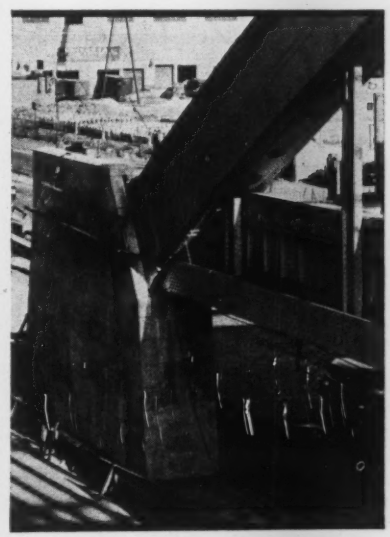

Fig. 3. Bridge abutment showing clean-cut character of steel and masonry.

Design considerations

For proportioning the parts of the arch proper, an equivalent live load (including impact) of 933 lb. per lin.ft. per lane was used, approximately equivalent to standard H-20 loading. The steel weighs 6,000 lb. and the roadway 5,600 lb. or a total of 11,600 lb. per ft. per truss. Unit stresses were $15{,}000\text{-}30l/r$ compression, and 18,000 lb. tension on the net section of the tie for *D.L.* + *L.L.* + Temp. For a combination of the above with wind load an increase in unit stresses up to 25 per cent was permitted. The top K-bracing was proportioned for a shear in the plane of the bracing of 350 times the gross section of the rib.

The hangers and their connections were designed for full dead load and

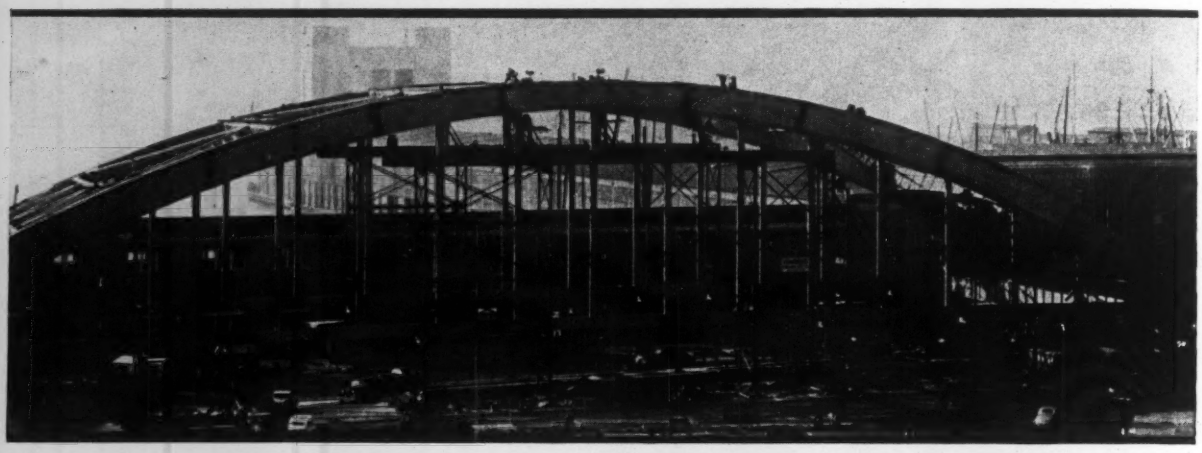

Fig. 4. During erection, Canal St. bridge was carried on special centering, providing supports for both rib and tie and leaving space between arches free for West St. traffic.

150 per cent of the live load, and the stress due to direct load and deflection of the floor under lateral forces does not exceed 18,000 lb. The additional fiber stress due to a wind force of 25 lb. per sq.ft. acting against the side of the hanger does not exceed 3,000 lb. per sq.in., in the worst case.

In the analysis, the tie as well as the upper chord was assumed to resist the bending moments. Because of the camber placed in the tie, the horizontal stress in the tie induces pulls on the hangers, which converts the entire system into an arch with a rise of 60 ft., and this dimension was used in the analysis.

The maximum vertical reaction at the abutment is 2,750,000 lb., and the tension in the tie 3,900,000 lb. If the tie had been pin-connected to the arch rib, the size of the pin would have been excessive, and the tie would have had to be thickened and expanded—all of which was precluded by the limited area available on the abutment. Since the rib and tie deflect together through the same angle, a riveted connection was used, with the elements of the arch rib converging upon the theoretical point of intersection of the lines of vertical reaction, horizontal pull and inclined arch thrust.

The stretch of the hangers makes the deflections of the tie slightly greater than that of the arch rib. This is not of much importance at the center of the arch but, at the hanger near the end of the arch, the secondary stresses in the tie become excessive. For this reason this tie is not connected to the end hanger.

The great width of the bridge raised the question whether some provision for lateral temperature variation would be required. However, computations indicated that the foundations themselves, resting on long piles at one end and on deep piers at the other, have a certain flexibility. This, together with slight clearances at the pins and rollers, as well as the flexibility of the ends of the chords themselves, was enough to allow the slight change, about one-sixth of an inch, without excessive stresses either on the bearings or on the rest of the structure.

Tie made short for erection

The dead load thrust of the arch causes the tie to stretch $1\frac{5}{8}$ in., and the arch rib to compress about 1 in.; or a total relative spread of $2\frac{5}{8}$ in. of the ends of the arch. This change in shape is accompanied by a sag of the rib (and of the tie which hangs from it), of varying amounts, from 0 in. at the abutments to $3\frac{1}{8}$ in. at the crown, and induces bending stresses of nearly 3,000 lb. per sq.in. in the rib and 1,200 lb. per sq.in. in the tie. These bending stresses were eliminated by inducing opposite bending stresses in the unloaded arch during erection, which stresses disappear when the arch is loaded. This was done by making the tie $1\frac{5}{8}$ in. shorter and the rib 1 in. longer than 360 ft.

In the erection scheme used the arch rib with its lateral and portal bracing was first riveted, followed by riveting of the tie at the ends and at two of the three intermediate splices. A gap of $2\frac{5}{8}$ in. was left at the center splice of the tie. To close the arch, the rib was jacked up (at the several points of support on the centering) the distances which it would sag down when the centering was removed and the full dead load was brought on the arch; then the tie was pulled together $2\frac{5}{8}$ in. (with a force of about 20 tons), closing the gap and permitting the splice to be riveted.

Personnel

The design of the arch was begun under Clifford M. Pinckney, chief engineer, borough president's office, and the design was completed and the structure erected under Walter D. Binger, commissioner of borough works, and Lester C. Hammond, chief engineer, Borough of Manhattan. The fabrication and erection was done by the Harris Structural Steel Co. Foundations were sunk by the Poirier & McLane Corp.

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French Mountain Tunnel To Be Completed

One result of the recent move by which all the French railways were taken over by the government and organized under the National Railway Co. is that the minister of public works has been authorized to enter into negotiations with the railway authorities and local governments for the completion of the long railway tunnel through the Vosges Mountains. Work on this tunnel was stopped some time ago, as driving through the hard rock proved more difficult and costly than had been expected, causing the funds allotted to be exhausted when the work was far from completion.

A Two-in-One Disposal Plant

HENRY W. TAYLOR
Consulting Engineer, New York

***Contents in Brief**—Sewage treatment and refuse incineration are combined in a single wastes disposal plant at Herkimer, N. Y. Operating experiences show how the two processes work to mutual advantage. Sludge gas is used for auxiliary fuel in the incinerator, and the heat derived from the latter is employed to accelerate sludge digestion.*

COMBINATION of a sewage treatment works with a municipal refuse incinerator to serve as a wastes disposal plant is readily justified from many angles of design and by the interchange of heat values and the opportunity for mutual assistance between the two processes. The new combination has taken its place as a municipal utility and is represented by installations at Canajoharie and Herkimer, N. Y. Operating experience at such a plant substantiates the general theory and objectives of the design, and for the purposes of this discussion the results at Herkimer may be cited as typical for the non-metropolitan districts.

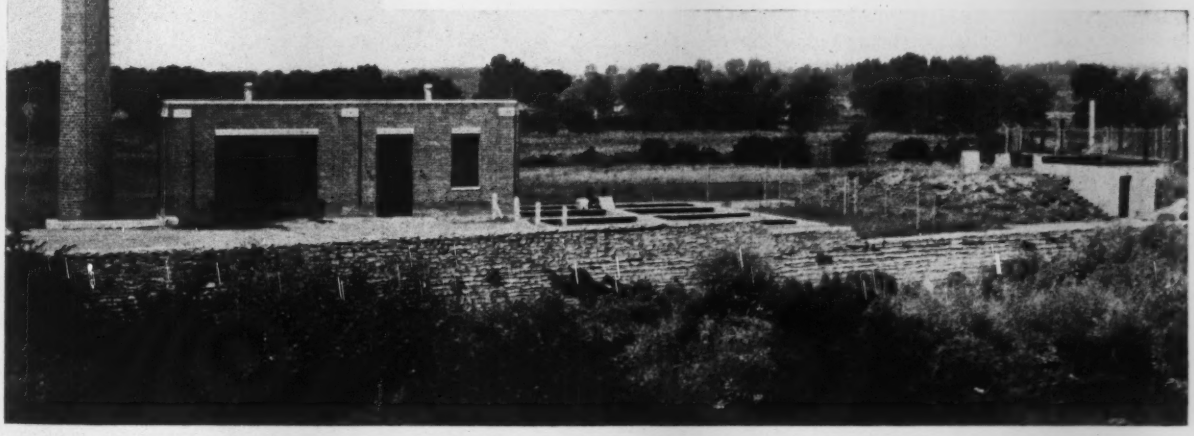
The Herkimer plant was designed for a future population of 12,000 people, with a sewage flow of 100 gal. per capita and refuse contribution of 1.4 lb. per capita for a 310-day year. The sewage works include sedimentation and separate sludge digestion, and the incinerator is a modified design of the basket grate type with forced draft. The plant structures include a building, 25 by 50 ft., settling tanks, sludge digestion tanks, control house and sludge drying beds (Fig. 1). The plant building contains the charging and stoking room floors of the incinerator, pump well, sewage pumps, machinery room, office and hot water tank and screen rooms.

Plan of operation

In the furnace and combustion chamber of the incinerator, hot water coils absorb heat from the gases of combustion. By means of forced circulation this heated water is delivered to a 3,000 gal. storage tank. The contents of the tank is heated to about 200 deg. F. during the run of the incinerator and the stored heat is circulated through the building heating system and through the heating coils of the sludge digestion tanks. Screenings from the incoming sewage are burned in the incinerator.

The sewage is screened through a bar screen with 1¼ in. clear spacing and lifted to the settling tanks by one or more of three sewage pumps. The pump discharge impinges against a metal roof plate, which acts as a splash plate to break out sulphide gases in suspension and these vapors are collected and vented. Settled sludge is collected by conveyors and ejected into the primary sludge tank. The plant effluent passes to the Mohawk River from an elevation above flood levels.

The two sludge tanks are operated in series. The primary tank has a fixed cover, under which a limited quantity of gas is stored for part of the day. The secondary sludge tank is equipped with a floating cover provided with a 5-ft. skirt below the ceiling plate for gas storage. Both tanks are heated. Sludge transfer may be effected either by hydraulic differentials or by gas pressure in the primary tank.



Refuse incinerator and sewage treatment combined in a single wastes disposal plant for the village of Herkimer, N. Y.

The wastes disposal plant was put in operation on Dec. 23, 1936, when the temperature in the primary digestion tank was 50 deg. F. By Jan. 27 the tank had been properly conditioned and heated and gas production was initiated with a pH of 7 and a tank temperature of 83 deg. On Feb. 6, the gas production was 710 cu.ft. and before the first of March, a regular supply of about 4,000 cu.ft. of gas was available. During the first six months period of gas production, the average daily supply amounted to 3,800 cu.ft.; in the second six months period, the average daily production amounted to 6,400 cu.ft. per day, giving a daily capita figure of 0.71. As the incinerator is used for only five or six hours, more than enough gas is available for auxiliary fuel. Because of inadequate storage facilities considerable gas is wasted.

During the initial stages of operation the primary sludge tank was first conditioned and placed in normal operation and all heating was concentrated in this tank. The overflow of the warm supernatant liquor to the secondary tank was sufficient to maintain its temperature at about 60 deg. At first the primary sludge was retained in the primary tank in order to quickly obtain a seeding of this tank. In the latter part of March, however, the operator started displacing primary sludge to the secondary tank when fresh sludge was introduced to the primary tank, and direct heating of the secondary tank was initiated.

Difficulties with sludge

In the secondary tank, additional digestion takes place as well as a high degree of concentration. On Sept. 10, when the first withdrawal of sludge was made it was so heavy that even with a head of 14 ft. between the secondary tank and the drying beds, the flow was so slow (through 600 ft. of 6 in. pipe) that it required five hours to fill one bed about 50 ft. square.

No apparatus was available at the plant for the determination of the moisture of this sludge but it was heavy enough so that it crept along the bed at a depth of about two inches before it would proceed to the dry bed area. As a result of this experience the writer has come to the conclusion that provisions for jetting at the bottom angle of a sludge tank, prior to withdrawal, should be provided. In the case where a floating cover is used this jetting can be accomplished by a pipe and nozzle introduced between the cover and the side wall and moved around the tank.

For conditioning the sludge digestion tanks, only a small amount of lime was required since the pH of the water supply was 7.6. However, during the conditioning of the primary tank, care was taken to spray the floating sludge by means of a jetter nozzle entering the gas dome. The riser of this nozzle may be raised or lowered and rotated so that the jetting action is radial to the tank. At no time in the operation of the primary tank has the depth of the top sludge exceeded six inches. Such top sludge as exists is black, fluid and easily submerged. Though jetting was carefully maintained during the early stages of starting the tank, only thirty hours of jetting between January 26 and April 26 were required to keep top sludge in good condition. As would be expected, there has been no tendency toward formation of scum or floating sludge in the secondary tank.

Settling tanks odorless

Due to the splash arrangement where the pumped sewage discharges, no odors have been detected from the open settling tanks, even at the effluent weirs. The Imhoff cone test of effluent indicated no readable quantity of settleable solids, although on long standing, a secondary precipitation seems to take place in the effluent under quiescent conditions.

The solids contribution per day produces about 400 cu.ft. of wet sludge. The tanks are frequently skimmed, and about once in six months they are drained and cleaned. The partial aeration of the raw sewage leads to grease segregation in the influent conduit and this material is skimmed off and ejected to the primary sludge tank. The settling tanks were designed with sloping bottoms, and this causes a reduction in velocity as the sewage flow proceeds through the tanks. The effluent is collected by a top weir and submerged multiple inlet headers whose capacity is subject to regulation.

Although the incinerator plant includes no truck scales it is estimated from periodic weighing and from records of loads that the furnaces annually consume 2,200 tons of mixed refuse.

Incinerator operation

In the summer, no circulation of hot water through the coils of the sludge digestion tanks is maintained in the day time except as required to reduce excessive temperatures in the hot water storage tank. During the operation of the incinerator, the temperatures of the storage tank will be raised from about 100 deg. to about 200 deg. and late in the afternoon the circulating pump on the return line of the sludge tank coils is placed in operation.

During the warm weather when plant heating is not required and heat losses from the sludge tanks are at a minimum, the gas-fired hot water boiler is not used at night and as previously stated, some of the gas produced when the incinerator is not in operation is lost through lack of sufficient storage.

In the process of utilizing the main body of the sludge gas in the incinerator, both burners were first used intermittently. Each of these burners consume about 900 cu.ft. per hr. It was found that with the use of two burners, a sufficient amount of unburned combustible to properly support the fire on the main grate was not available. Experience dictated that one burner only be used continuously.

It should be understood that the normal refuse of the Mohawk Valley region is fairly rich in garbage and this advanced knowledge dictated the design of the combination plant wherein the sludge gas could be used as an auxiliary fuel. Collection of waste oil from garages has also been initiated and this oil is also used as an auxiliary fuel. The effectiveness of the sludge gas as an auxiliary fuel is demonstrated (with some allowances for other factors) by the fact that whereas 12 tons of soft coal were originally required per month, the present use of coal is approaching three tons per month. The advantages of sludge gas as an auxiliary fuel are that it does not have to be shoveled, leaves no ash and costs nothing.

Cost data

Exclusive of pumping charges (current for which is supplied by the

municipal power plant) the operating cost of the wastes disposal plant is $2,500 yearly. The total cost of the project including land, engineering, overhead and construction was $82,000, 45 per cent of which was obtained as a grant from PWA funds.

Operation of the plant, which was designed by the writer, is under the direction of D. B. Rasbach, city engineer, who kindly supplied the data on recent operating results.

Lamp Measures Bitumen Content

Light bulb and photronic cell tell Wisconsin state highway engineers the bitumen percentages of road mixes

A PORTABLE and quick-reading field testing device for determining the bitumen percentages of road mixes is being used with encouraging results by Wisconsin state highway engineers. As described by A. T. Bleck, construction engineer, in a paper read at the recent Montana Bituminous Conference (*ENR* Oct. 27, 1938), the device makes use of the principle that light passing through a colored solution loses intensity in some proportion to the strength of the solution. The operation is to extract the bitumen from the mix, pass the light through the bitumen-solvent, take a galvanometer record and by a simple calculation read the bitumen percentage directly from a calibration table.

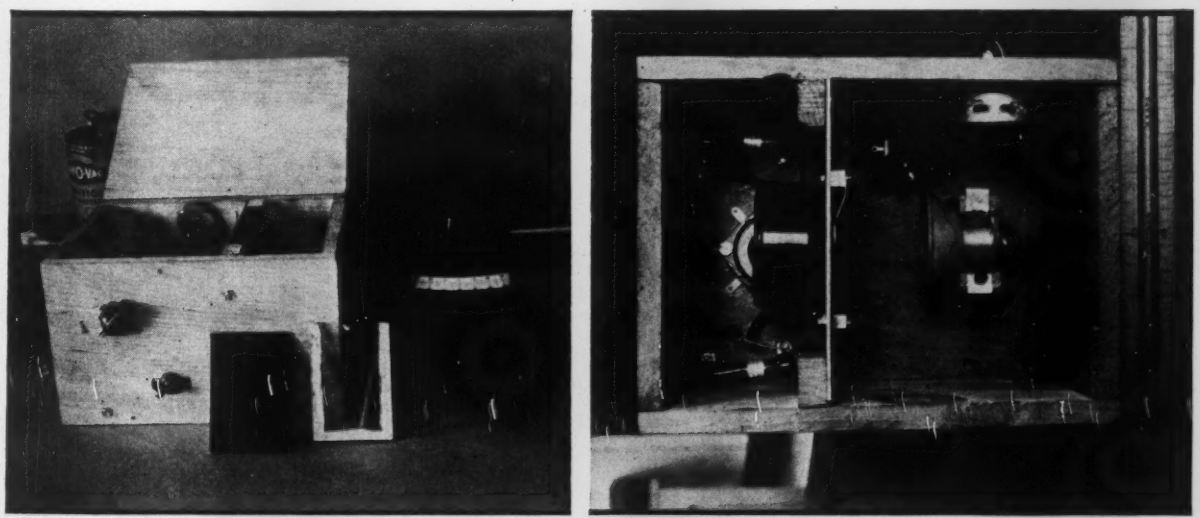
The accompanying views show the device as arranged for field use. It consists of (1) a source of light of known intensity mounted in a parabolic reflector and energized by six No. 6 dry cells connected in series parallel to give 4.5 volts; (2) a photronic cell which receives the beam of light after it passes through the solution that is being measured; (3) a galvanometer of a sensitivity of 0.15 microamperes per millimeter; (4) fixed resistors of 1,000 and 1,500 ohms which are in circuit with the photronic cell and the galvanometer for controlling the sensitivity of the circuit and "damping" the galvanometer; (5) a rheostat and a toggle switch which opens and closes the circuits; (6) a standard red filter which is used to protect the photronic cell and to check the set-up of the instrument, and (7) transmission cells which carry the solutions that are to be measured.

The apparatus, except the battery and galvanometer, is enclosed in a covered box containing one compartment for the light circuit and another for the photronic cell and the resistors.

The operation is as follows: The galvanometer needle is adjusted to read zero. The standard filter is placed between the source of light and the photronic cell. The current switch is thrown on and the amount of light passing through the filter is regulated by the rheostat until the galvanometer reads 50.

After setting the needle at 50 the bulb is allowed to remain lighted for 5 min. but not more than 10 min. By readjusting the rheostat and with the filter in position, the needle is made to read between 49 and 51. The exact reading is taken and identified as R_F. Then the filter is moved forward and a transmission cell containing the bitumen-solvent solution is placed in position behind the filter. The latter is then removed, the box containing the instrument is closed, and a reading identified as R_M is taken on the galvanometer. The filter is placed in position back of the transmission cell, the latter is removed, the box is covered and a check of the value of R_F is made—the reading should not vary by more than 0.1 mm.

The reading R is then calculated by the formula $R = (R_M - R_F +$ cell correction. With the value for R, the percentage of bitumen present in the sample is read from calibration tables which are furnished with the instrument.



Apparatus devised by Wisconsin state highway engineers measures bitumen content of road mixes: (left) batteries, instrument case and galvanometer (right) lamp, photronic cell and rheostats in position in the case.

FROM FIELD AND OFFICE

Working problems and time-saving methods . . . Edited by Charles S. Hill

SIMPLE SCRATCH TEMPLET

This scratch templet being used in an unusual position but designed for straightforward paving was seen on street paving work in Wilmette, Ill. It consists of a steel channel fitted at the ends with skids for riding the forms and drilled for bolts with sharpened ends to scratch-mark irregularities in the subgrade.

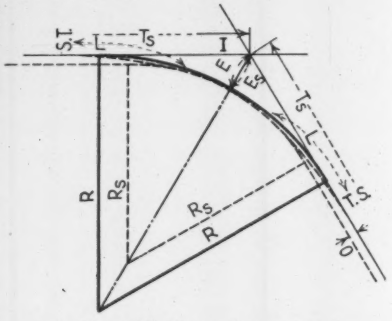
• • •

Revising Highway Curves

W. T. HUGHES
Washington, D. C.

The increased safety and speed built into the modern automobile and the subsequent increase in the speed limits in many states calls for a revision in the design of curves that were built for the lower speed of a few years back. The revision should include superelevating the surface on the curve and the placing at the ends of spirals.

The most economical method of rebuilding those curves would be to hold as nearly as possible to the present location. This can be done by using the center of curve as a base and increasing the degree of curve an amount that will allow for a proper length spiral at each end of curve. The following method will meet the above conditions.



Let R = Radius of present curve
R_s = Radius of new curve to be spiraled
O = Offset
D = Degree of original curve
D_s = Degree of new curve
L = Length of spiral in 100′ stations
I = Intersection angle
$O = .0727\ D_s\ L^2$ (From Talbot spiral)

$$R - R_s = \frac{O}{Vers\ \frac{1}{2} I}$$

substituting $.0727\ D_s\ L^2$ For 0 and $\frac{5730}{R_s}$ for D and solving for R_s we have

$$R_s = \frac{R}{2} + \sqrt{\left(\frac{R}{2}\right)^2 - \frac{416.57\ L^2}{Vers\ \frac{1}{2} I}}$$

(see sketch)

—Example—

$I = 60°$
$L = 3.00$ (300′)
$D = 6°$
$R = 955.37$

From equation

$$R_s = \frac{R}{2} + \sqrt{\left(\frac{R}{2}\right)^2 - \frac{416.57\ L^2}{Vers\ \frac{1}{2} I}}$$

$R_s = 925.12$
$D_s = 6°\ 11.78'$ or $6.196°$

—Proof—

External distance of 6° curve and intersection angle 60° = 147.80
From Talbot spiral

$E_s = (R_s + O)$ exsec $\frac{1}{2} I + O$
$O = .0727\ D_s\ L^2 = 4.054'$
$E_s = 147.79'$ which is within .01 foot of desired location of center of curve.

From the above information the tangent distance from point of intersection to point of spiral on tangent can be computed by $Ts = t + (R + O)$ tan $\frac{1}{2} I$ (Talbot spiral), and curve staked out from this point.

$t = \frac{1}{2}$ length of spiral—correction $.000127\ a^2\ L^5$, in which $a = \frac{D_s}{L}$.

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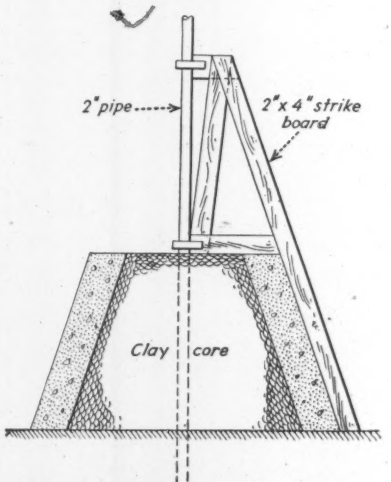
Molding Manhole Cones

A successful way to mold conical sections of concrete manholes is shown by the accompanying sketch. No form is required. The operation



Device for molding manhole cones.

is described as follows by R. F. Mirick, construction engineer, in the Official Bulletin of the North Dakota Water and Sewerage Works Conference, Bismark, N. Dak.:

The essential tools are a piece of 2-in. pipe 8 ft. long and two 2 x 4-in.

Safe Loads on Planks

SAFE LOADS IN POUNDS ON PLANKS FOR SCAFFOLDS, RUNWAYS, ETC. AS REPORTED BY CONSOLIDATED BUILDERS, INC., GRAND COULEE DAM, MASON CITY, WASH.

(Figures are for concentrated center loads; they may be doubled for uniformly distributed loads.)

Kind of Timber	Size	Span in Feet										
		4	6	8	10	12	14	16	18	20	22	24
Douglas Fir	2x10	870	570	415	310	250	200	165	...	...	...	...
	2x12	1,000	680	500	370	300	240	200	155	...	...	...
	3x14	2,400	1,560	1,150	900	720	600	500	420	350	300	250
Western Hemlock	2x10	760	500	360	270	220	175	145	...	...	...	...
	2x12	875	595	440	325	260	210	175	135	...	...	...
	3x14	2,100	1,365	1,005	790	630	525	440	370	305	260	220
Spruce or White Pine	2x10	540	360	260	190	160	125	105	...	...	...	...
	2x12	625	425	310	230	190	150	125	95	...	...	...
	3x14	1,500	975	720	560	450	375	310	260	220	190	155

strike boards. The strike boards are fastened to the pipe with two iron straps in such a way that the boards will revolve about the pipe. Drive the pipe into the ground, plumb, on a spot near the manhole excavation. Tamp clay around the pipe to form a core using trowels to cut and shave the clay to the shape outlined by the strike board. When the core is complete, lift the strike off the pipe and replace it with one built to a larger radius. Mix the concrete very stiff, and plaster it around the core, revolving the strike to get the right shape. Cure the concrete in the usual manner; on very hot drying days bury it in sand or dirt after initial set has taken place.

To put the conical sections in place dig out under the section, insert skids and slide the section down into the manhole excavation over the barrel of the manhole. Then put about six timbers over the excavation; set a heavy sawhorse on them; use a chain block to lift the conical section a little and swing it to place; put some mortar in the joint and lower the cone. For hoisting the conical section a block 6 in. thick and shaped to fit inside the section is used; it is made of three pieces of 6 x 6-in. timber with a ¾-in. eyebolt.

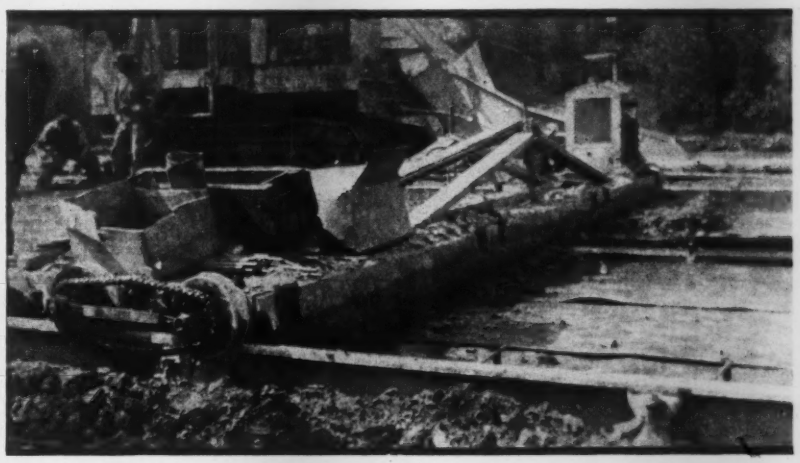
• • •

A Job-Made Strikeoff

by C. O. BAKER
Resident Engineer,
Kansas Highway Commission,
Kansas City, Kan.

The striking off of fresh concrete in pavement construction to allow the placing of wire mesh, is simplified and speeded up by the use of the home-made mechanical strike-off illustrated.

The device consists of a rigid frame supported on each form by three wheels, two of which are set up front close together and are geared to provide traction. The third wheel is placed 6 ft. from the front to keep the strike-off from twisting sideways. The frame is kept from sagging by two transverse trusses set between the two front wheels. Jack screws at the center permit adjustment. Two plates hinged to the front of the frame to permit raising and lowering do the grading. The bottoms of the plates are cut to the required crown and to the proper depth below the forms. The device is chain-driven by a small two-cylinder gas engine. Only one man is required to operate the strike-off under normal conditions. The device is especially helpful if the concrete is being vibrated and low-slump mixes are being used.



Home-made device strikes off slab for placing mesh reinforcement.

This strike-off was used by the J. A. Tobin Construction Co. on recent paving laid on the new Reidy Road superhighway, a Kansas highway commission project located immediately west of Kansas City, Kan.

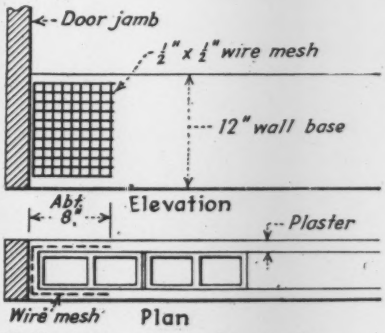
• • •

Preventing Wall Cracks

RUSSELL C. BRINKER
Assistant Professor of Engineering,
University of Hawaii, Honolulu, Hawaii

Several valuable practical features have been incorporated in recently constructed University of Hawaii buildings upon the suggestion of W. Cuthill, university inspector on the structures.

In building interior partition walls of 4-in. concrete hollow blocks, the bottom row of blocks is entirely filled with mortar. The mortar adds weight and aids in tying the blocks to the roughened concrete floor. The bottom row of blocks which ordinarily receives the hardest blows from heavy furniture being moved is thus better protected from displacement and cracking. A 1-in. deep slot with a width equal to the width of the hollow tile (obtained by a board sunk into the floor slab during pouring) will also prevent displacement of the blocks and gives lateral support to the wall.



Wall reinforcement at door jambs.

To prevent cracking of the wall base adjacent to door jambs, a strip of ½ x ½-in. wire mesh is placed around the base for its full height as shown in the accompanying sketch. The mesh is carried back about 8 in., and placed about ¼ in. from the surface of the inch thickness of plaster or mortar. Wire mesh is also embedded in the base where door stops are fastened to the wall and thus subject the plaster to impact loads.

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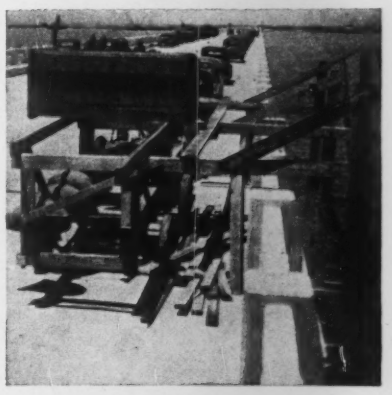


TRUCK MOUNTED SCAFFOLD

To scour some 16,000 ft. of facia girder and railing on the new Galveston Causeway, the contractor devised a staging cantilevered out from a truck chassis as shown by the illustration.

BOOK NOTES AND REVIEWS

The month's additions to the engineer's reading and reference list

Highway Curves

TRANSITION CURVES FOR HIGHWAYS—By Joseph Barnett. 211 pp. Published by the U. S. Bureau of Public Roads. For sale by the Superintendent of Documents, Washington, D. C. Price 60c.

Transition curves have long been accepted practice on railroads and all handbooks for railroad engineers outline the fundamentals for laying out such curves and provide tables to simplify the operations. This book provides similar information for engineers in highway work where spirals for curves are rapidly gaining acceptance. Most of the book is given over to tables which have been designed for highway use and so are better for that purpose than railroad transition curve tables. Also included is information on methods for widening pavements on curves and data on superelevation.

Sewage Disposal

MODERN SEWAGE DISPOSAL—371 pp. Published by Federation of Sewage Works Associations, New York. Price $2.50 to subscribers of *Sewage Works Journal;* non-subscribers $3.50.

When the Federation of Sewage Works Associations laid plans for its tenth anniversary, it was decided to issue a book on sewage disposal in lieu of holding a convention. As a result there has now been made available a most unusual text on the subject. Gathered together in a single volume are contributions from thirty-five outstanding authorities in the field both here and abroad. Under the editorship of Langdon Pearse, sanitary engineer of the Chicago Sanitary District, the work of these specialists has been arranged to give an integrated picture of the art from its earliest developments to present-day practice and trends.

Divided in 32 chapters, the book furnishes comprehensive coverage of all phases of the subject, dealing with operative and administrative aspects of sewage disposal as well as with treatment methods and technique. Enhancing its usefulness still further are chapters devoted to English, German, Dutch and South African practice.

The treatise is destined for a unique place in the literature of sanitary engineering—it is an historical record, a working manual of good practice and a compendium of knowledge in sewage disposal.

Formulas and Tables

ENGINEERS' MANUAL—Second Edition—By Ralph G. Hudson. 340 pp. Published by John Wiley & Sons, New York; Chapman & Hall, London. Price $2.75.

Fundamental mathematical formulas in algebra, trigonometry, mensuration, analytical geometry and calculus are assembled in convenient form in this book, also those of kinematics, relations of mass and space, kinetics and statics. For the civil engineer there are formulas relating to stresses in framed structures, properties of materials, beams, columns and hydraulics. Other sections relate to mechanical and electrical engineering. Tables are the usual ones found in small handbooks with the addition of a very convenient one of conversion factors.

For All Concrete Men

CONCRETE MANUAL—454 pp. Published by the U. S. Bureau of Reclamation, Customhouse, Denver, Colo. Price $1; $1.12 outside of North America.

By publishing a practical digest of its extensive laboratory and field experience the U. S. Bureau of Reclamation has made a major contribution to the art of concrete construction. The "Concrete Manual" is perhaps the decade's most important addition to our working concrete literature. The bureau's practice, outgrowth of more than thirty years of field experience in a single continuous organization and shaped to its present-day form by the remarkable researches and developments that began with the initiation of the Boulder Dam project, is acknowledged as preëminent, and it is this practice that the manual expounds and makes available to concrete workers.

The book is so rich and varied in content that it can not well be described in summary. But as brief indication of its scope the theme of its main divisions may be stated. Part I condenses current knowledge of concrete behavior and its causes into a compact, well-balanced document (66 pp.). Part II described methods of exploring and testing aggregates (36 pp.). Part III takes up the main subject, concrete production and content. It covers the processing of aggregates, mix proportioning according to strength and consistency, machine batching and mixing, control of consistency, methods and precautions in placing and curing finishing procedures, and finally special concretes and repair work (163 pp.). The remaining 153 pp. of the book, while equally essential to the general theme, are appendices which reproduce many bureau specifications for test methods and an elaborate collection of mix tables and diagrams.

Though addressed to construction engineers and inspectors, many others will find the manual useful.

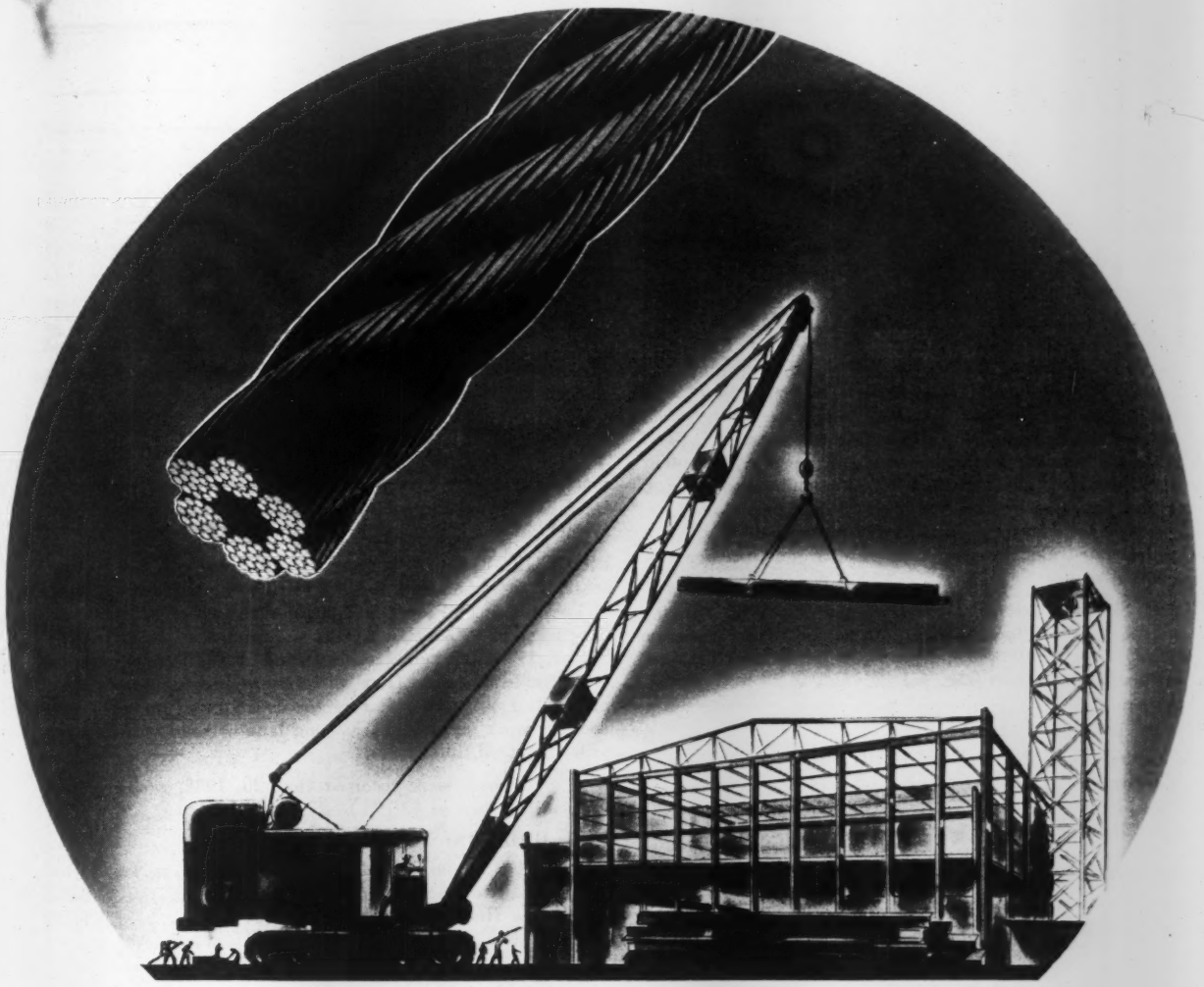
MISCELLANEOUS NOTES ON BOOKLETS AND REPRINTS

HOW TO RAISE MONEY for sewage disposal, with special emphasis on the revenue bond service charge method, is discussed in "Financing Sewerage Works", a publication of the Portland Cement Association, 33 West Grand Ave., Chicago.

A HANDBOOK FOR SUPERVISORS AND FOREMEN, prepared under the direction of Col. Brehon Somervell, WPA Administrator at New York, contains much sound advice on matters of handling men and public relations that could well be read by foremen on any public undertaking.

THE AIRPORT DILEMMA, a 45 pp. brochure, is a review of local and national factors in airport planning and financing put out by the Public Administration Service, Chicago. It was compiled jointly by the American Municipal Association and the American Society of Planning Officials. A

(*Continued on p. 88*)



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CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

GRADE SEPARATION, MICHIGAN

OWNER: Wayne County Road Commission, Detroit; L. C. Smith, Engineer.

PROJECT: Construction of outer drive (Bonzano Ave.) and Michigan Central, New York Central and D. & T. S. L. railroad grade separation at Ecorse, Mich.; also grading and water main for the grade separation. Total length of excavation is 1,300 ft. Separation is a 94-ft. two-span bridge which carries six railroad tracks over two 30-ft. pavement strips and two 10-ft. sidewalks. 14-ft. clearance is to be provided under bridge. Stipulated contract time is 210 calendar days; transportation facilities by rail and highway are available. Construction is to be carried on without interruption of railroad or pedestrian traffic by means of a run-around track and a pedestrian detour.

BIDS: Six bids were received December 15, 1938, ranging from the contract low of $305,400 to $344,390. Minimum wage rates are as follows: Skilled, $1.50 per hr.; semi-skilled, $1.00 per hr.; common, 75c. per hr.

LOW BIDDERS:

1. W. J. Storen Co., Detroit (contract) $305,400
2. Jutton Kelly Co., Detroit 308,694
3. Hamer Bros., Inc., Detroit 318,539

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Const., maint. and removal, pedestrian detour	L.S.	$500.00	$500.00	$500.00
2. Railroad trackwork for perm. and runaround track const	L.S.	27,000.00	21,000.00	22,000.00
3. Break. exist. pav	4,700 s. y.	.10	.10	.10
4. Gen. excav. to subgrade	43,500 c. y.	.52	.45	.57
5. Conc. in stairs	17 c. y.	30.00	31.00	29.00
6. Pipe handrail, complete, on stairs	128 l. f.	3.00	4.00	3.00
7. 18-in. reinf. conc. bell and spigot sewer.	58 l. f.	2.75	2.25	3.00
8. 15-in. reinf. conc bell and spigot sewer.	465 l. f.	2.50	2.10	2.00
9. 12-in. reinf. conc. bell and spigot sewer.	1,447 l. f.	2.00	1.95	2.00
10. 8-in. bell and spigot sewer	496 l. f.	1.00	.65	.75
11. 6-in. bell and spigot sewer with cemented joints from gate wells, lighting manhole, etc	4,030 l. f.	1.00	.50	.50
12. 6-in. bell and spigot sewer pipe slope drains with open joints, 3 ft. or less in depth	1,000 l. f.	.80	.60	.60
13. 6-in. bell and spigot sewer pipe slope drains with open joints, 3 ft. to 6 ft. in depth	640 l. f.	.90	.75	.80
14. 6-in. bell and spigot sewer pipe slope drains with open joints, 6 ft. to 9 ft. in depth	500 l. f.	1.00	1.00	1.25
15. 6-in. bell and spigot sewer pipe slope drains with open joints, 9 ft. to 12 ft. in depth	500 l. f.	1.00	1.40	1.50
16. Sewer manholes	14 ea.	100.00	80.00	75.00
17. Catchbasins	27 ea.	50.00	50.00	50.00
18. Furnishing new 16-in. cast iron bell and spigot water pipe	1,350 l. f.	3.10	3.10	3.25
19. Furnishing new 10-in. cast iron bell and spigot water pipe	60 l. f.	1.60	1.60	1.75
20. Furnishing new 6-in. cast iron bell and spigot water pipe	100 l. f.	.85	.90	1.00
21. Bell joint clamps for 16-in. water pipe	20 ea.	14.00	15.00	20.00
22. Furnishing new specials for 6-in., 10-in., and 16-in. water pipe	6,740 lb.	.07	.07	.10
23. Furnishing 16-in. D.W.S. water gate	2 ea.	175.00	175.00	175.00
24. Gate wells complete with frame and cover	4 ea.	70.00	375.00	425.00
25. Laying 16-in. water mains, specials and gates	1,350 l. f.	2.25	3.00	2.75
26. Laying 10-in. water main; gates, and specials	720 l. f.	1.50	1.20	1.50
27. Laying 6-in. water main, gates, and specials	870 l. f.	1.50	1.00	1.25
28. Porous backfill for abutments, piers, walls, and struts	1,750 c. y.	1.70	2.00	2.00
29. Conc. paving subbase — 10-in	1,690 s. y.	2.10	1.60	1.50
30. Cofferdams for abutments, piers, and walls	L.S.	62,000.00	75,000.00	72,000.00
31. Sheetpile walls between cofferdams	120 l. f.	40.00	50.00	37.00
32. Excav. in cofferdams and trench excav. for struts	9,330 c. y.	1.50	1.10	1.50
33. Conc. abutments, walls, piers, seal coat, and struts	3,807 c. y.	12.50	13.00	13.20
34. Conc. in bridge deck	67 c. y.	30.00	20.00	20.00
35. Rubbed surface finish	11,000 s. f.	.10	.12	.15
36. Heating and housing conc	1,500 c. y.	.10	.25	.50
37. Reinf	158 ton	70.00	76.00	80.00
38. Furn. struc. steel bridge	642.2 ton	92.00	92.00	91.00
39. Unloading and erecting struct. steel	642.2 ton	16.50	17.00	18.00
40. Ornamental steel railing bridge and wing walls	286 l. f.	6.50	6.10	7.00
41. Pipe railing on bridge and walls	573 l. f.	3.70	3.30	3.00
42. Membrane waterproofing bridge deck	7,310 s. f.	.09	.10	.10
43. Mastic base and protective covering for membrane waterproofing	6,100 s. f.	.40	.60	.75
44. Dampproofing backs of abutments and walls	10,940 s. f.	.04	.03	.04
45. 8-in. cor. iron pipe for struct. drainage	962 l. f	1.10	1.00	1.00
46. Permanent bridge lighting from cable pole to bridge lights	L.S.	1,400.00	1,000.00	1,500.00

OVERPASS REMOVAL, IOWA

OWNER: Iowa State Highway Commission, Ames; F. R. White, chief engineer.

PROJECT: Removing an overpass structure on Iowa 60 at crossing of abandoned line of Northwestern Railway south of Lovillia, and grading and paving the gap of 173 ft. Overpass is a 112-ft. wooden trestle. Contract is to be started by May 1, 1939, and completed by June 15. Rail transportation is available one mile from site. Owner furnishes temporary guard rail materials. Contractor is required to plan and conduct work so that at least one lane of road will be open to traffic at all times.

BIDS: Six bids were received Dec. 20, 1938, ranging from the contract low of $5,198 to $7,528.

LOW BIDDERS:

1. Paul B. Reis, Des Moines (contract) $5,198
2. E. A. Kramme Co., Inc., Des Moines 6,253
3. G. G. Herrick, Des Moines 6,730

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Cl. II excav. rdy. & borrow	7,024 c. y.	.28	.48	.50
2. Remove present pav	140 s. y.	.58	.50	.75
3. Std. conc. pav., Cl. II	411 s. y.	3.85	3.50	3.90
4. 3-in. slope curb	510 l. f.	.60	.10	.10
5. 24-in. reinf. conc. pipe	132 l. f.	3.00	2.50	3.00
6. Type B flumes Cl. A., cr. stone	2 ea.	75.00	80.00	75.00
7. Cl. B gravel	100 c. y.	3.25	3.00	3.00
8. Metal slope drain	78 l. f.	2.00	2.50	1.50
9. Finish earth shoulders	173 l. f.	.25	.20	.25
10. Removal of old overpass	L. S.	200.00	300.00	450.00

STORM SEWERS, MISSOURI

OWNER: City of St. Joseph, Mo.; C. A. Haskens, Finance Building, Kansas City, Mo., engineer.

PROJECT: Constructing 1,225 ft. of 9-ft. Brown Branch storm sewer. Sewer is to be monolithically-cast reinforced concrete laid in open cut excavation. Stipulated contract time is 180 days. Transportation facilities by rail, highway and water are available.

BIDS: Eight bids were received Nov. 18, 1938, ranging from the contract low of $51,101 to $68,892. Minimum wage rates are as follows: Skilled, $1.00 per hr.; semi-skilled, 75c. per hr.; common, 60c. per hr.

LOW BIDDERS:

1. C. J. McCoy, Emporia, Kansas (contract) $51,101
2. J. A. Tobin Construction Co., Kansas City, Kan. 51,318
3. Freeney Construction Co., St. Joseph, Mo. 56,213

(Contract unit prices continued on page 81)

(Contract Unit Prices continued from page 78)

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Excav.	5,500 c. y.	$0.50	$0.75	$1.45
2. 9-ft. conc. reinf.-cut section	860 l. f.	32.00	33.50	32.00
3. 9-ft. conc. reinf. fill section	157 l. f.	38.00	37.00	38.00
4. 9-ft. conc. reinf. piling section	208 l. f.	46.00	42.80	44.00
5. Piles (untr.)	4,830 l. f.	.90	.52	1.00
6. Extra cl. A conc.	10 c. y.	20.00	20.00	18.00
7. Extra cl. B conc.	30 c. y.	15.00	12.00	10.00
8. Extra reinf.	2,000 lb.	.05	.05	.045
9. Driving test piles	L. S.	200.00	500.00	200.00

PONTOON BRIDGE, SEATTLE

OWNER: Washington Toll Bridge Authority, Olympia.

NOTE: The following three schedules complete the unit price report on the Lake Washington Pontoon Bridge. A description of the job and the first five schedules were published Jan. 26. Schedules 6, 7, 8, were run Feb. 2. A summary of the remaining schedules follows: unit No. 9, east channel bridge, consisting of two 60-ft. concrete spans, two 180-ft. steel deck spans, one 215-ft. steel through arch span, three 180-ft. steel deck spans and two 60-ft. concrete spans, totaling 1,355 ft.; unit No. 10, grading and paving on east side of Lake Washington, 2,000 ft.; unit No. 11, concrete spans of 10 ft., 30 ft., 49 ft., 68 ft., 49 ft., 30 ft., seventeen units at 30 ft., 47 ft., 64 ft., 80 ft., 64 ft., and 47 ft., totaling 2,578 ft.

UNIT NO. 9

Contract time, 420 days; high bid of four, $591,568.

LOW BIDDERS:

1. Puget Const. Co., Clarkston (contract) $527,010
2. Puget Sound Bridge & Dredging Co., Parker-Schram Co., Seattle 552,977
3. General Const. Co. & Columbia Const. Co., Seattle 567,545

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Struct. excav. cl. "B"	1,120 c. y.	10.00	25.00	26.00
2. Struct. excav. cl. "C"	1,165 c. y.	9.00	20.00	22.00
3. Struct. excav. cl. "D"	755 c. y.	7.00	15.00	12.00
4. Struct. excav. cl. "E"	640 c. y.	3.00	5.00	3.00
5. Conc. cl. "A" on steel spans	1,095 c. y.	20.00	31.00	28.00
6. Conc. cl. "A" in conc. struct	950 c. y.	24.00	22.00	26.00
7. Conc. cl. "B"	2,010 c. y.	22.00	20.00	22.00
8. Conc. cl. "D"	3,270 c. y.	16.00	12.00	18.00
9. Steel reinf. bars	828,500 lb.	.05	.045	.05
10. Struct. steel	8,285,000 lb.	.085	.085	.08
11. Cast steel	49,000 lb.	.20	.16	.18
12. Cast bronze	2,800 lb.	1.00	.70	.60
13. Cast steel drains	28 ea.	25.00	30.00	25.00
14. Reinf. conc. bridge railing	2,740 l. f.	3.00	4.00	4.50
15. Reflector units	2 ea.	5.00	10.00	10.00
16. Lumber (untreated)	120 m.b.m.	80.00	80.00	60.00
17. Timber piling (untreated)	6,000 l. f.	.15	.20	.20
18. Driving timber piles	120 ea.	10.00	12.00	10.00
19. Removing struct.	L.S.	3,000.00	2,500.00	6,000.00

UNIT NO. 10

Contract time, 270 days; high bid of ten, $151,164.

LOW BIDDERS:

1. N. Florito Inc., Seattle (contract) *$92,836
2. Florito Bros. Inc., Seattle 98,530
3. Northwest Const. Co. Inc., Seattle 98,956

*Adjusted to $60,934.

No. Item	Quantity	Unit Prices (1)	(2)	(3)
1. Remov. conc. pav't	4,450 s. y.	.25	.15	.20
2. Sel. roadway borrow	15,810 c. y.	.65	.50	.45
3. Conc. pav't 9 in. x 6½ in. x 9 in. std. 14 day mix	9,760 s. y.	1.65	1.74	1.75
4. Pav't reinf. type No. 2	46,730 lb.	.045	.05	.05
5. Dowel bars with rubber caps	3,420 ea.	.22	.19	.22
6. Dowel bars without rubber caps	8,080 ea.	.15	.11	.13
7. Gravel backfill	50 c. y.	3.50	2.50	3.00
8. Finishing roadway	72 stas. (100 ft.)	10.00	6.00	15.00
9. Slope treatment	5,620 l. f.	.08	.08	.10
10. Clearing	16 acre	150.00	175.00	200.00
11. Grubbing	10 acre	150.00	175.00	200.00
12. Excav. uncl. incl. haul of 600 ft.	108,240 c. y.	.18	.25	.235
13. Struct. excav. incl. haul of 600 ft.	300 c. y.	1.25	1.00	1.25
14. Excav. cl. "D" incl. haul of 600 ft.	400 c. y.	1.25	.75	1.25
15. Overhaul on above materials	22,780 c. y. stas.	.01	.01	.01
16. Overhaul on above materials	53,600 c. y. mi.	.10	.10	.10
17. Conc. pavt. 10 in. x 7 in. x 10 in. std. mix	8,710 s. y.	1.75	1.85	1.85
18. Conc. pavt. 10 in. x 7 in. x 10 in. high early strength	150 s. y.	1.95	2.10	2.00
19. Conc. pavt. 9 in. x 6½ in. x 9 in. high early strength	3,690 s. y.	1.80	1.92	1.90
20. Conc. pavt. bridge app. slabs std. mix	180 c. y.	10.00	10.00	12.00
21. Hand placed riprap	30 c. y.	8.00	10.00	5.00
22. Cable guard rail des. No. 6	690 l. f.	.75	.60	.70
23. Sta. guard rail type No. 3	3,590 l. f.	.75	.60	.55
24. Sta. conc. RW markers	20 ea.	1.50	1.75	2.00
25. Sta. conc. gutter	1,400 l. f.	.60	.50	.60
26. Prep. of rdy. and spreading and brooming top course	800 s. y.	.35	.05	.20
27. Cr. gravel surf. top course	100 c. y.	3.50	3.00	3.00
28. Bit. cem. MC-2	2 tons	30.00	25.00	30.00
29. Spec. conc. catch basin	2 ea.	50.00	30.00	50.00
30. Spec. conc. inlet	6 ea.	25.00	30.00	40.00
31. Relay exist. plain conc. or V.C. pipe, 12-in.	90 l. f.	.75	.30	.50
32. Relay exist. plain conc. or V.C. pipe, 18-in.	60 l. f.	1.00	.40	.60
33. Dipped corr. iron pipe, 8-in.	250 l. f.	.85	.90	1.00
34. Plain conc. or V.C. culv. pipe, 12-in.	180 l. f.	.75	.75	.80
35. Std. reinf. conc. culv. pipe, 18-in.	120 l. f.	1.65	1.60	1.75
36. Removing exist. bull rail	270 l. f.	.15	.10	.20
37. Removing exist. catch basin	L.S.	15.00	25.00	10.00
38. Removing exist. guard rail	600 l. f.	.15	.10	.20

UNIT NO. 11

Contract time, 450 days; low bid of five, $766,943.

LOW BIDDERS:

1. Rumsey and Co., Seattle (contract) *609,175
2. Bates & Rogers Const. Corp., Chicago 648,419
3. J. H. Pomeroy & Co. Inc., Parker-Schram Co., Portland, Ore. 689,534

* Adjusted bid $329,332.

No. Item	Quantity	Unit Prices (1)	(2)	(3)
1. Struct. excav.	11,900 c. y.	4.00	.58	2.00
2. Conc. Cl. "A"	10,600 c. y.	22.00	28.00	24.75
3. Conc. Cl. "B"	2,200 c. y.	20.00	17.05	24.00
4. Conc. Cl. "D"	1,340 c. y.	18.00	8.10	11.50
5. Steel reinf.	3,518,800 lb.	.0425	.05	.055
6. Reinf. conc. bridge rail	6,608 l. f.	3.00	4.50	4.80
7. Furn. tbr. found. piling (creos. tr.)	12,320 l. f.	.60	.45	.82
8. Driving tbr. found. piles (creos. tr.)	308 ea.	10.00	9.60	13.50
9. Furn. tbr. found. piling (untr.)	198,000 l. f.	.20	.20	.26
10. Driving tbr. found. piles (untr.)	2,830 ea.	8.00	9.25	8.50
11. Furn. and driv. tbr. test piles	3 ea.	100.00	315.00	400.00
12. Cast steel drains	86 ea.	25.00	21.20	34.00
13. Struct. steel	76,000 lb.	.15	.115	.15
14. Reflector units	6 ea.	10.00	8.25	12.75
15. 3½-in. galv. wrought steel pipe	180 l. f.	3.00	1.00	4.00
16. Rdy. borrow	5,000 c. y.	.50	.70	.50
17. Roadway connections (est.)	Actual cost	800.00	800.00	800.00

SEWERS, CORTLAND, N. Y.

OWNER: City of Cortland, N. Y.: Glenn D. Holmes, consulting engineer, Syracuse, N. Y.

PROJECT: Construction of contract No. 2, sanitary sewer. To be located under Port Watson St., Central Ave., and on private rights-of-way. Stipulated contract time is 100 days. Liquidated damages are $25 for each day over the stipulated time during which the contract is not finished. Certain existing sub-surface structures are likely to be encountered during construction.

BIDS: Four bids were received Jan. 4, 1939, ranging from $11,784 to $14,980. Minimum labor rates are as follows: Skilled, 75c. per hr.; semi-skilled, 60c. per hr.; common, 45c. per hr.

LOW BIDDERS:

1. Antonio Mondo, Syracuse $11,784
2. Simiele Construction Co., Inc., Syracuse 12,372
3. C. D. Murray Co., Inc., Syracuse 14,085

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing	L. S.	$50.00	$250.00	$400.00
2. General excav.	50 c. y.	.50	1.50	.50
3. Trench. under 4 ft.	1,750 l. f.	.40	.20	.40
4. Trench. 4 to 6 ft.	1,100 l. f.	.45	.25	.50
5. Trench. 6 to 8 ft.	780 l. f.	.70	.50	1.25
6. Trench. 8 to 10 ft.	50 l. f.	2.00	.55	1.50
7. Trench. 10 to 12 ft.	30 l. f.	3.00	.60	1.60
8. Lining	10 c. y.	3.00	3.00	1.50
9. Manhole frames, covers type "A"	8 ea.	25.00	25.00	25.00
10. Manhole frames, covers type "B"	8 ea.	20.00	20.00	25.00
11. Std. manholes	110 l. f.	12.00	11.00	12.00
12. Reinf.	500 lb.	.10	.06	.05
13. Cl. "A" conc.	5 c. y.	15.00	20.00	15.00
14. Cl. "B" conc.	5 c. y.	9.00	18.00	15.00
15. Cl. "C" conc.	190 c. y.	10.75	12.00	11.00
16. Brick masonry	5 c. y.	10.00	35.00	30.00
17. 4-in. V. C. P. sewer	50 l. f.	.25	.50	.25
18. 6-in. V. C. P. sewer	20 l. f.	.40	.55	.30
19. 8-in. V. C. P. sewer	1,000 l. f.	.50	.70	.40
20. 12-in. V. C. P. sewer	1,500 l. f.	.80	1.00	.70
21. 12-in. cement asb. sewer	1,170 l. f.	1.75	2.20	1.20
22. 4-in. V. C. P. spls.	5 ea.	1.00	1.00	.50
23. 6-in. V. C. P. spls.	5 ea.	1.50	1.25	.70
24. 8-in. V. C. P. spls.	20 ea.	2.00	1.50	1.00
25. 12-in. C. I. pipe	12 l. f.	5.00	3.00	3.25
26. Street crossing	L. S.	350.00	500.00	2,000.00
27. Reconnecting house laterals	5 ea.	5.00	15.00	15.00
28. Reconstructing manhole inverts	1 only	50.00	50.00	150.00
29. Remove and rebuild storm sewer	L. S.	1,000.00	700.00	1,000.00
30. Engineer's office	L. S.	500.00	500.00	1,000.00

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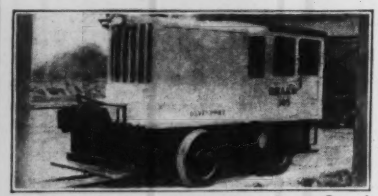
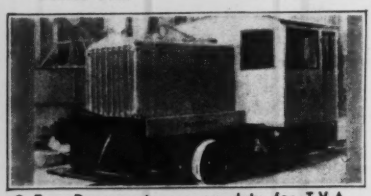


● Fourteen of these are at work on Grand Coulee Dam



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WRITE FOR CATALOG

DAVENPORT LOCOMOTIVE WORKS

DAVENPORT, IOWA

Division of Davenport Besler Corporation

News continued from page 43

MEN AND JOBS

CHARLES F. WRIGHT, city engineer of Lake Worth, Fla., has been elected president of the Florida state board of engineering examiners.

LLOYD RUFF, formerly instructor in geology at the University of Oregon, has joined the staff of the U. S. Engineers on the Willamette Valley project.

FLOYD ELLIS, assistant county engineer since 1934 at Mount Vernon, Ohio, has been made county engineer there. Ellis, a graduate of Ohio State University, was formerly with the state highway department.

LADISLAS SEGOE has resigned the post as consulting engineer to the Cincinnati Regional Planning Commission which he has held since the organization of the commission ten years ago.

ELMER J. GRIMMETT has been put in charge of engineering work for the General Foods Corp. and will be attached to the headquarters staff in New York. For the past six months Grimmett has been resident engineer in charge of construction of the company's new plant at Hoboken, N. J. He has been with General Foods since 1930.

JOSEPH LEIMBACH, chief inspector of the highway bureau of the borough of Queens, New York City, has retired from that post at the age of 76. Leimbach entered the service of the city as inspector in 1898 and has been chief inspector since 1928.

JOHN S. LAUGHLIN has been appointed consulting engineer for the borough of Queens, New York, replacing Oscar Erlenson who is retiring at the age limit.

W. C. HOWE has resigned the post he has held for the past 3½ years in the construction department of the TVA at Chickamauga Dam. Howe is returning to the Duke Power Co. as assistant engineer on construction of a new steam plant near Shelby, N. C.

ELMER O. BERGMAN has joined the staff of the J. P. Braun Co. of Alhambra, Calif. He is continuing the work on elasticity problems for which he was awarded a doctorate last spring by Stanford University. Bergman has been associate professor of civil engineering at the University of Colorado.

WILBAR M. HOXIE, formerly of the Natick office of the Metropolitan Water Supply Commission of Massachusetts, has become an engineering aide at the U. S. Engineer Office in Providence, R. I. Hoxie graduated from the University of New Hampshire in 1938.

STERLING J. PETTIT, assistant engineer of Mercer County, N. J., has been appointed engineer of Hamilton Township, Trenton, N. J.

CARL MCCOY has been appointed Whatcom County engineer at Bellingham, Wash.

R. P. RYKER has been appointed Okanogan County engineer at Okanogan, Wash. For six years previously, Ryker was at Kittitas County as assistant county engineer and later county engineer. Earlier, he spent nine years with the state highway department.

H. D. BOSSERT, research supervisor of housing for the Iowa state planning board, has resigned to become Nebraska field engineer for the Structural Clay Products Institute. His headquarters will be at Omaha.

VICTOR K. GAMBLE has been appointed secretary of the Ohio Paving Brick Manufacturers Association. It was erroneously reported in our issue of Dec. 5 that Gamble had been appointed secretary and chief engineer; he is not chief engineer.

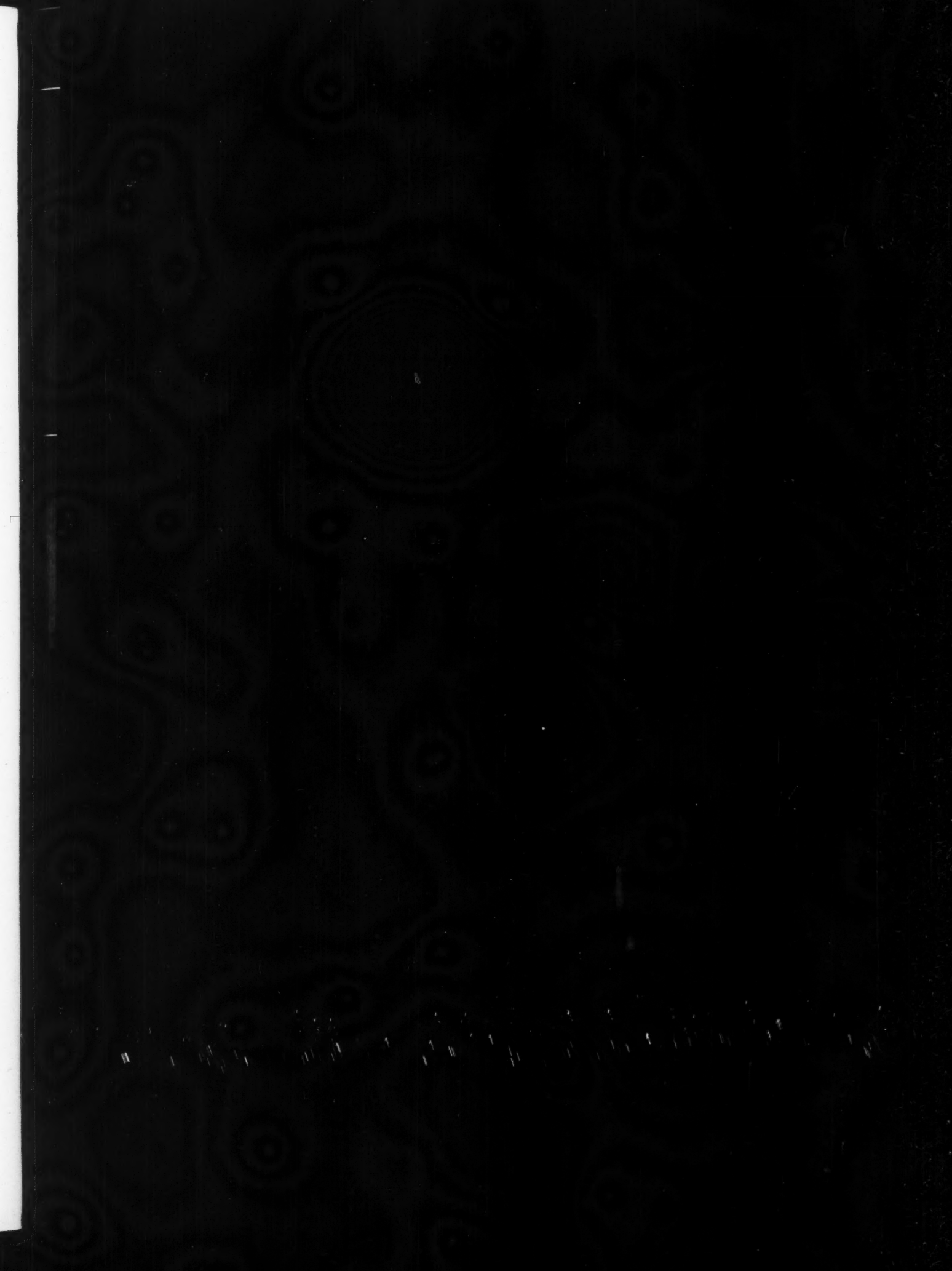
CAPT. LLOYD E. MIELENZ will be transferred April 1 from his work on the Memphis, Tenn., flood control project for the U. S. Engineers Office to duty in the Philippine Islands. He will be succeeded by Capt. Harry Meyer, now at Buffalo.

MEETINGS

NATIONAL SOCIETIES

SOUTHWEST ROAD SHOW AND SCHOOL, Coliseum, Wichita, Kan., Feb. 21–24.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS and Louisiana Engineering Society, Spring meeting, St. Charles Hotel, New Orleans, Feb. 23-25.

AMERICAN CONCRETE PIPE ASSOCIATION, annual convention, Hotel St. Francis, San Francisco, Feb. 23-25.

THE ASPHALT INSTITUTE, twelfth national asphalt conference, Biltmore Hotel, Los Angeles, California, Feb. 27–March 3.